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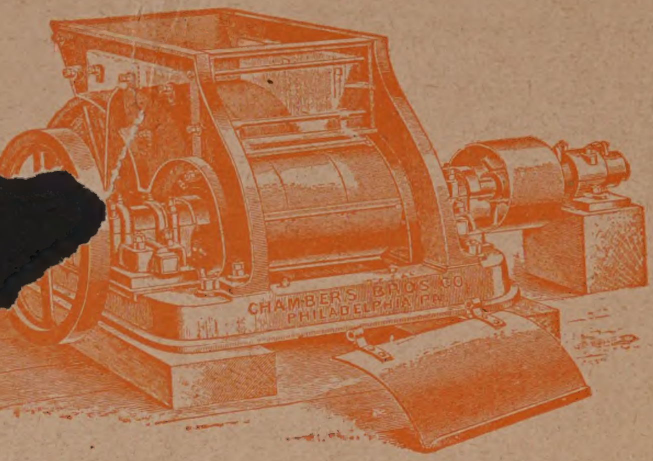

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BRICK AND MARBLE IN THE MIDDLE AGES.

G. EDMUND STREET.

CHAPTER VIII.

> "Break, break, break,
> On thy cold, gray stones, O sea!
> But the tender grace of a day that is dead
> Will never come back to me."
>
> *Tennyson.*

PADUA AND VENICE RAILWAY — VENICE: PIAZZA AND CHURCH OF ST. MARK — TORCELLO — THE LAGOON — MURANO — STA. MARIA DEI FRARI — SS. GIOVANNI E PAOLO — STA. MARIA DELL' ORTO — OTHER CHURCHES — DOMESTIC ARCHITECTURE — FONDACO DE' TURCHI — OTHER BYZANTINE PALACES — THE DUCAL PALACE — FOSCARI PALACE — CA' D' ORO — OTHER GOTHIC PALACES — BALCONIES — VENETIAN ARCHITECTURE — A FESTIVAL — PAINTINGS.

LITTLE is to be seen as one leaves Padua to distinguish the city at all vividly save the Oriental looking cupolas of Sant' Antonio, and the great roof of the Sala della Ragione, looking like the inverted hull of some great ship, with its convex sides towering up above the otherwise not remarkable-looking city.

And now our destination was Venice, and anxiously we looked out ever and anon, impatient, long before the time, to see the tall outline of St. Mark's campanile against the horizon. The view was too contracted to be really beautiful; on each side of the railway rank and luxuriant hedges of acacia sprouted their tall branches above the carriages, and beyond them might be seen plantations of maize, flax, and other crops, all remarkable for their prodigious growth and size, and watered by countless small canals, and here and there with turgid, muddy-looking streams rushing on from the mountains to discharge themselves into the Adriatic, and gliding between great artificial banks, which gave them the appearance rather of large canals than rivers. Nothing breaks the dead monotony of the scene, for it is misty, and the Tyrolese Alps, which ought to show their jagged peaks to the north, are invisible. The stations follow each other in quick succession, and at each stand some diligence or carriage whose ingrained panoply of white dust, added to that which rises here and there white and cloud-like in the dry glare of the Italian sun, which beams overhead, makes one feel grateful that — however unpoetical such a mode of approach may be — a railroad carries us to Venice. Nor is such a country as this along which one passes, from Padua to Venice, without its moral. I suppose there is nothing more certain than that, ordinarily, the appreciation of high art, and success in its practice, have never been so marked in countries whose natural features are lovely as in those in which the devoutest student of nature's beauties can see nothing to admire or love. So Venice, surrounded by waters, and then by a country which would be entirely tame and uninteresting were it not for the exquisite distant views of the Friulan Alps, fell back on her own resources, and provided herself with that substitute for the loveliness of nature which, alone of man's works, the loveliness of beautiful art can be. And perhaps it is better for the traveller that no interest should be felt save in the end of the journey, where the journey has so brave an end!

At last, however, the broad, watery level of the Lagoon is reached; Venice rises out of the water at a distance of some two miles; and then, across an almost endless bridge, the railway takes us into the outskirts of the city. A confused idea of steeples and domes is all that is obtained, and one finds one's self going through that most painful of processes to an excitable man, the usual examination of luggage. At last, however, we are outside the station, the Grand Canal lies before us, and we are vehemently urged to get at once into an omnibus-gondola. But no, this is too absurd a bathos for our first act on entering Venice, and we step, therefore, into a private gondola, and, propelled rapidly and lightly over the still, unruffled water, sink at once into that dreamy kind of happiness which, of all conveyances in the world, the gondola is best calculated to encourage. A short reach of the Grand Canal is soon passed, and then, with the picturesque cry of warning, "*Ah, stali!*" we turn sharply into a narrow canal to the right, and, shooting down the tortuous street of water, presently cross the Grand Canal again, midway between the Rialto and the Foscari Palace, dive into another canal still narrower than the former, and at last, after frequent glimpses of mediæval houses and palaces, find ourselves safely housed at our hotel, close to the Grand Canal, and within two or three minutes' walk of the Piazza San Marco.

We stopped but a short time here, so impatient were we to obtain our first glimpse of the church and palace of St. Mark, to which Venice owes much of her fame. We passed along some narrow, winding alleys, lined on either side with open shops, on the counters of which lie exposed for sale not over-dainty looking edibles, and in whose dim interiors little light of day seems ever to enter to help the busy workmen who may always be seen there plying their trade; and then, going under an archway crowded with busy folk in rather noisy consultation, we found ourselves, in four or five minutes, standing under the arcade at the upper end of the great Piazza San Marco. Long lines of regular architecture arcaded below, heavy with cornices, and elaborated windows above, carry the eye not unpleasantly down to the lower end of the piazza, at the right-hand angle of which towers up into the air a vast campanile, simple and unbroken in its outline, without visible window or any buttress-like projection, until its upper stage, where it has a very simple, open, arcaded belfry, capped with a pyramidal roof; and then across nearly the whole width of the piazza, and partly concealed by the curiously irregular position of its campanile, stretches the low, singular, and Eastern-looking church of St. Mark. Before it rise the masts from which of yore hung waving in the wind the banners of the old Venetian state, and crowds of pigeons, fed here by civic liberality, cover the pavement with their pleasant fluttering presence. The charm of the west front is certainly most indescribable, and I confess to feeling a doubt as I looked at it whether it was not more akin to some fairy-like vision, such as one might see in dreams, than to any real and substantial erection of stone and mortar; for, indeed, to a mind educated in and accustomed to the traditions of Northern Gothic, there is something so very *outré* in the whole idea, something so startling in its novelty, that it is hard at first to know whether to admire or not. It is far from imposing in size, but yet, as it is looked at more and more carefully, it grows much and rapidly on one's love, and at last imprints itself on the mind as a real work of art of a very beautiful and unusual kind, wrought out with an abundance of beautiful detail, but in such a way as to prevent its being possible that it could ever be absolutely reproduced or taken as a model.

As you pace down the broad level space of the Piazza the feeling of the strangeness of the whole scene increases. There are of course no horses, and no vehicles of any kind; it is a large square in which all the space is footpath, and on which, in addition to the many men who pace it rapidly with busy brow, or idly lounge whilst enjoying the weather and the place, hundreds of pigeons are constantly fluttering or walking about in quiet confidence, sure that they will not be molested by any one. And then, as one draws near to the church, it is easy to understand rather better than at first in what its real charm lies; this is, no doubt, before anything else, in its beautiful color; the whole front is shafted to a greater extent than almost any building I know, the shafts all rather heavy, but of marble of the richest kind; the groining of the seven entrance arches is filled with mosaics, and the walls are encrusted everywhere with marble. Instead of ordinary gables masking the roof, the front is finished with great ogee gables most extravagantly crocketed, and obviously a modern alteration of the orignal Romanesque finish; behind these a cluster of fourteenth-century cupolas completes the view. Of the seven arches which compose the façade, four have doorways; the outer arches on either side are very narrow, and answer in width to the kind of cloister which masks the church on the south, west, and north sides; and the central arch is much wider and loftier than the others, rising, indeed, so high as to break through the line of balustrading which runs across the front just above the other arches.

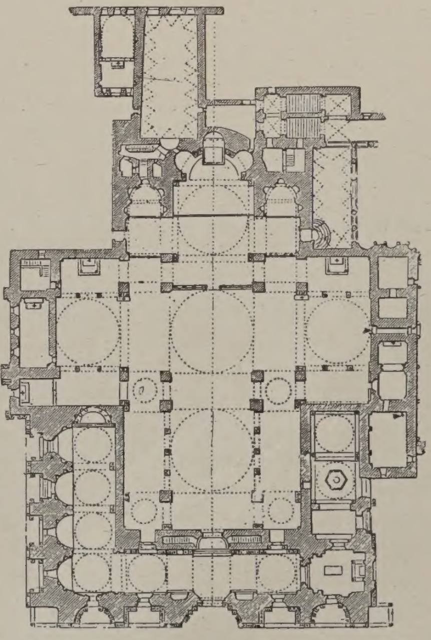
Within this central arch is a grand doorway, the stilted semicircular arch of which is of three orders, the central plain, the others covered with carvings. The piers supporting the main arches have tiers of shafts in two heights, the lower tier corresponding in height with those of the doors pierced within the arches, and the others, which are smaller in diameter, and more numerous than those which support them, rising to the springing-line of the main arches. The side doorways have very Eastern-looking arches, the semicircular line being carried on nearly to the centre, and then turned up into an ogee. These and some other portions, as *e. g.*, the windows over two of the doors, and the pinnacles between the gables, belong to the fourteenth century, whilst the finish of the gables themselves — great ogee crocketed gables with figures at the apex of each — is probably of the fifteenth century. All these archways open into the cloister, or narthex already mentioned. Here, where the roofs still glow with the most precious early mosaics, and the walls with marble, either used as inlays or for shafts, one gets a first and not unworthy hint of the beauty which awaits one in the interior.

And then, on entering the nave, the deep tones of an organ are heard reverberating through the old building; many people kneel devoutly at their prayers around us; the hot glare of the sun has gone, and in its place a cool, quiet, dim light reveals the whole magnificence of the design. It is quite in vain to describe this in formal architectural terms. The color is so magnificent that one troubles one's self but little about the architecture, and thinks only of gazing upon the expanse of gold and deep, richly tinted mosaic, all harmonized together into one glorious whole. The mosaics commence throughout the church at the level of the crown of the main arch dividing the nave from the aisles, and are continued up the remainder of the wall and into the domes; even the angles or arrises of the walls and arches are covered with gold mosaic; so that all architectural lines of moulding are entirely lost, and nothing but a soft, swelling, and undulating sea of color is perceived. There is nothing violent or garish in all this profuse decoration. The gold mosaic, used as it always is in early works, set irregularly in, and surrounded by a white line or joint of plaster, is never conspicuously bright; the drawing of the figures and subjects may be criticised, but at any rate it is always direct, simple, and intelligible, and the colors of the draperies bright and harmonious, whilst the arcading and wall-lining which fills the lower part of the walls is all of marble, which has now a rich, warm, but quiet tint, singularly suitable as a base to the more gorgeous coloring of the upper part of the walls and domes.

Altogether this is a church beyond most others suggestive of worship. Other churches sometimes suggest the same feeling, either by enormous size or vast height. At Köln or Milan man feels so small and so contemptible in comparison with the vastness of his own work that he is subdued in spite of himself. In countless other great Gothic minsters the same feeling is produced. But at St. Mark's it is produced in an intensified degree, and by a building the scale of which is in every way small, if not almost insignificant. There is no long vista of arches, no complicated perspective, and no vast height to awe the beholder, yet the mystery of color does for it even more than the mystery of size does for Köln or Beauvais, Milan, Toledo, or Bourges. It is, therefore, emphatically a church for worship, one in which even the most careless treads with hushed footstep and bated breath, and where, in spite of crowds, an awful silence seems always to reign supreme save when it is broken by the religious sound of the services of the church.

The ground plan is no doubt known to most of my readers. It is a typical example of the Greek or Eastern church as distinguished from the Romanesque, a cross whose arms are not far from equal, covered by a series of cupolas, one in the centre, one to each of the three eastern arms, and two to the western, with aisles to the nave and choir, and a cloister round the north, west, and south sides of the nave, of which the two former are the porches, and the latter the baptistery of the church.[1]

Under the eastern limb of the cross is a crypt, which has in recent years been opened and drained, and is now always open to inspection. This is divided under the choir into five aisles in width by a multitude of small shafts carrying quadripartite vaults, and in the centre of which, just under the choir altar, is the shrine of St. Mark. Another apse is formed under the south aisle of the choir, and under the north aisle is a corresponding crypt, save that there is no apse to it. Much modernized as this has been in the course of repair, and entirely devoid of all color or decoration as it is, it is still full of character, and adds largely to the interest of the church.



GROUND PLAN, S. MARK, VENICE.

(*To be continued.*)

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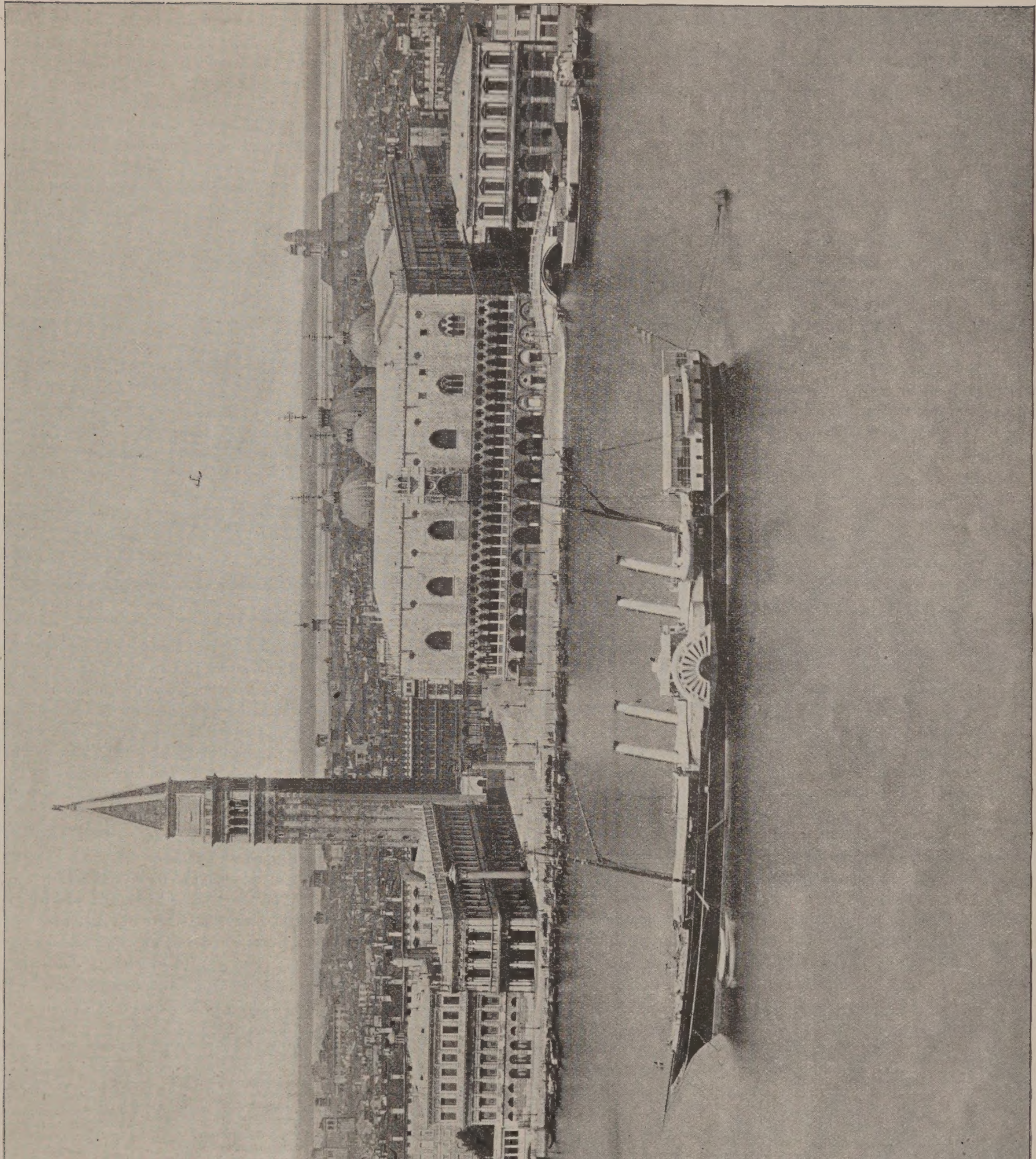
[1] The dimensions are worth giving to show how little this church owes to mere size. It is 245 feet long, 201 feet across the transept, and 170 feet across the west front. The height of the central cupola is 90 feet, and that of the west front, 72 feet.



VIEW OF THE PIAZZA S. MARCO, VENICE, SHOWING CAMPANILE AND DUCAL PALACE.
Supplementary Illustration to "Brick and Marble in the Middle Ages."

THE ART OF BUILDING
AMONG THE ROMANS.

Translated from the French of Auguste Choisy by Arthur J. Dillon.

CHAPTER II. — Continued.

II. VAULTS WITH ARMATURES OF BRICKS LAID FLAT.

(*Continued.*)

THE ancients, in building armatures of flat-laid bricks, had a double purpose: first, to give the rubble a continuous and solid support; and, second, to obtain a strong bond between it and the armature. We have seen how they attained this in two celebrated monuments, — Hadrian's Villa and the Baths of Caracalla, — but the type of armature used in these colossal vaults was susceptible to much simplification for ordinary use. The advantages it presented could be obtained at a smaller cost, and what we now have to study are the modifications made by the Romans in order to render the system more economical of labor or of materials.

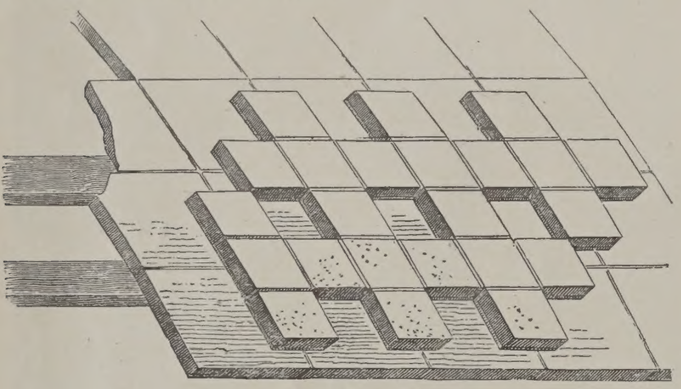


Fig. 32.

The type which differs the least from the two preceding examples is this in Fig. 32. The first layer was continuous, but the second was reduced to the bricks covering the joints of the lower bed, a simplification which was adopted in some of the rooms of the Palace of the Cæsars, and, if one may judge by the imprints, the armatures of the vaults of the Sette Sale, the reservoir near the Baths of Titus (Plate IV., Fig. 4), were much the same. The principal advantage of this arrangement of the second layer was that it required a smaller number of bricks, and was, at the same time, a means of establishing a strong bond between the rubble and the armature.

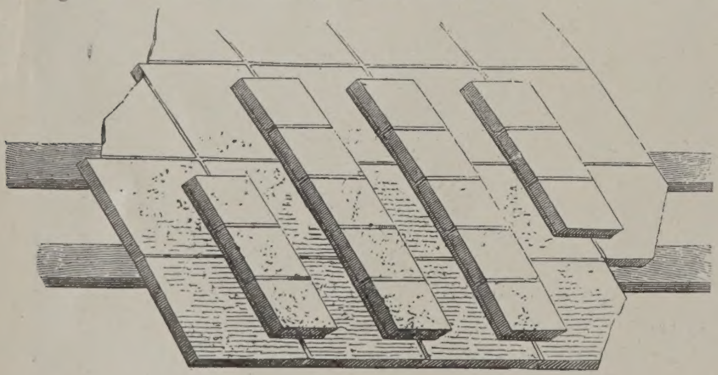


Fig. 33.

But the ancient builders did not stop here; in place of covering all the joints of the first layer, they contented themselves with placing bricks along the joints perpendicular to the axis of the vault, so that the armature consisted of a continuous layer of bricks re-enforced by ridges of smaller bricks, which, in the opinion of the Roman architects, served both to cover the joints and as ribs. This combination is to be found in many of the tombs of the Appian Way, and I give in Plate IV. (Fig. 3) the details of the vault of one of them, which is in a remarkably good condition; the bricks in the first layer are forty-five centimeters (one by one half foot) on a side, while those which cover the joints are only twenty-two centimeters. The mortar which lay in the joints has been washed away in the course of time, so that it is difficult to find traces of it, but one can easily find them in the so-called Villa of the Quintilii, which stands at the left of the Appian Way, not far from the tomb just mentioned. In the other monuments along the same road, the idea of using the second layer of bricks purely and simply to protect joints is expressed still more clearly and decidedly. Here the bricks of the second layer no longer form continuous zones, but are isolated, and are placed only at the angle common to four bricks, where the effects of a shock or of excessive pressure would be most disastrous.

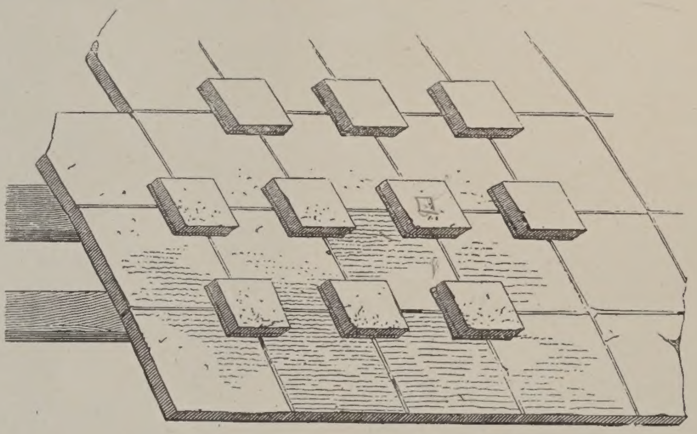


Fig. 34.

In order to be more economical, it was necessary to suppress the second layer entirely. The Romans took this last step on the way of simplification, and came to the construction of vaults on one layer of bricks alone; but the cases where the armatures are so reduced are relatively rare, and I was able to find but a single barrel vault where this elementary arrangement was well marked. This was in the Circus of Maximus (Plate IV., Fig. 1), outside of the gate of St. Sebastian, where all the vaults which carry the tiers of seats are built on a single layers of large bricks.

The use of armatures of flat-laid bricks in ancient vaults was very general; we shall meet them in vaults of the most complex forms as well as in barrel vaults; we shall see them indifferently used for the vastest halls, like those of the Baths of Carcacalla and for the narrowest galleries of the smallest aqueducts. In the last case they were often reduced, as in numerous galleries of the aqueducts opening into the arena of the Coliseum (Fig. 35), to two bricks about sixty centimeters square leaning against each other, and sometimes, as in the detail in Plate XIII., to a simple, single, horizontal brick.

Moreover, these armatures of flat-laid bricks were used for supporting not only vaults composed of horizontal courses of small stones and mortar. It often happened that the Romans built isolated brick arches with radiating joints, and it is to be remarked that they were invariably built on this system of armatures. I may cite as examples of isolated arches with radiating joints built in this manner the portico of an amphitheatre near the church of Santa Croce, in Gerusalemme, and an arch from the Baths of Caracalla. (Fig. 36.)

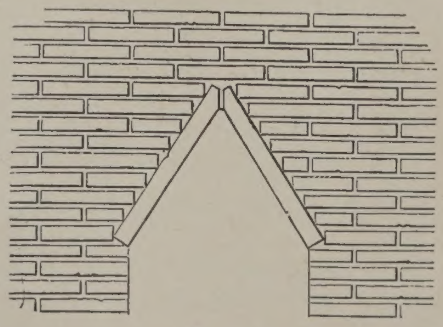


Fig. 35.

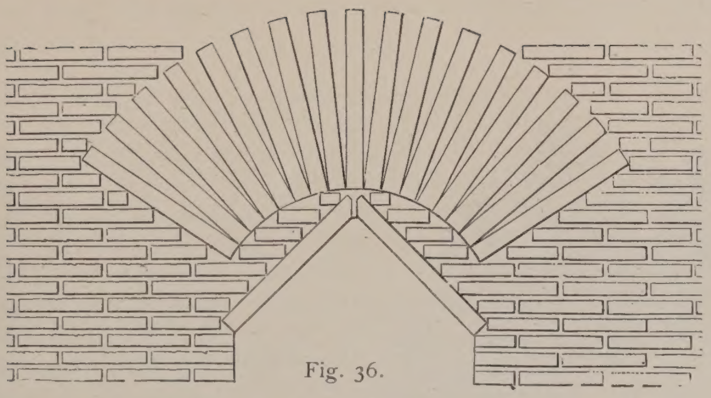


Fig. 36.

In concluding, I must call attention to the four great vaults which form, as it were, the side aisles of the immense hall at the centre of the Baths of Caracalla. In the entire edifice, and, I might add, among the great vaults of the Roman monuments that I examined, these barrel vaults alone have converging joints. Their masonry is composed of alternate layers of large bricks and tiles united by mortar. I give in Plate V. a view of one of these vaults, and it may be seen that this material with converging joints, as well as the rough, stratified masonry of the other vaults, rests on a double shell, in every detail, even to the headers, like those we have above described.

One can judge, from these many examples, how general was the use of these armatures in the ancient vaults; and their use, formerly so widespread, has not been entirely abandoned by the Italian builders. More than once have I watched them laid in the same country where, two thousand years ago, they were used with a success to which the Roman ruins still testify. They are yet very frequently employed in Rome itself, and the cloister-vaults which decorate the palaces of the modern city are, for the greater part, constructed with flat-laid bricks, like the vaults of the Baths of Caracalla, the intrados being ordinarily formed of a single layer of brick, and the rest being of the roughest rubble.

Tradition has, however, slightly modified the relative importance of the armatare and of the body of the vaults. Formerly the Romans considered the brick armature only as an auxiliary support for the rubble, and the rubble as the real vault, as the only part on which the architect could rely for the solidity and durability of his works. To-day, reversing the old opinion, it is the curved lining which is considered as the essential element, the active part of the vault. And sometimes this change of view is so marked in modern vaults that the rubble is reduced to a filling near the springing. Only the flanks are backed with rough masonry, and the parts near the summit are simply covered with broken stone. The Italian workmen call this class of work "*volta alla volterrana*," and sometimes by the expressive name of "*volta a foglio*."

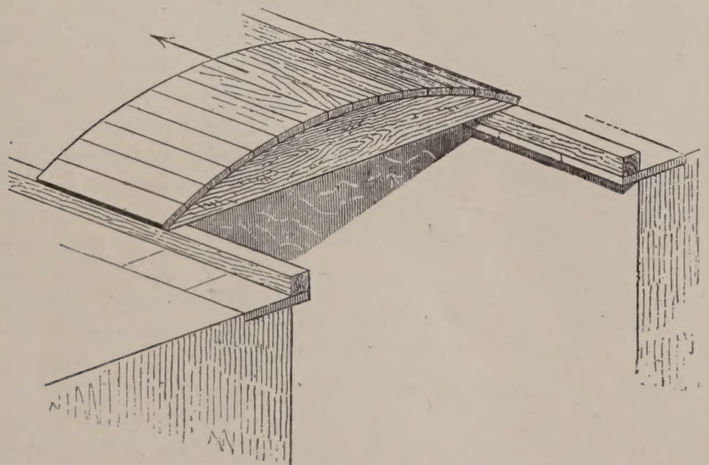


Fig. 37.

These vaults are seldom used in France in our days; yet their employment was frequent during the last century, and the details which Blondel gives of them are worthy of being recalled here (see *Cours d'Architecture*, t. VI., chap. II.). Flat vaults (for such they were called) were suddenly introduced into French architecture about the beginning of the eighteenth century, but in adopting them the architects were only renewing the tradition of the methods of the masons of Roussillon, preserved from a far distant past. And for an immemorial time the workmen had proceeded in the following manner: Joists were laid along the walls of the hall to be vaulted (Fig. 37), and on these was placed a movable centre about two and one half feet wide; on this were laid two layers of brick which were set in and bound together by mortar, exactly as in Italy, and exactly as among the Romans themselves; when one zone was finished the centre was pushed along the joists and a second zone laid, and so on. Then the thin vault thus built was strengthened with a filling which, though in a more modest form, corresponded with the masses of rubble in the ancient vaults.

The construction, as can be seen, was entirely in the spirit of Roman methods; the countries where it was in use adjoined the colonies of Provence, so it is probable that the method itself was a legacy of Rome. Be this as it may, the analogy is certainly remarkable, and it is not unimportant to find our explanations confirmed by a description of a still recent system of construction which agrees in every detail with the conjectures suggested by an examination of the Roman ruins alone.

GROINED VAULTS.

The questions so far taken up have been those relating to barrel-vaults. In passing to the study of groined vaults, it is my desire to mark the characteristics given to them by the Romans, to present clearly the methods of their construction, and to show, by examples, how the ideas I have been developing apply equally to these forms.

It is known, in a general way, that the ancients avoided penetrations; in the amphitheatres of Arles and of Nimes, where the circling corridors and the radiating passages cross each other in all directions, there is not a single instance of an intersecting vault; only a few intersections of unimportant barrel-vaults can be found in the arena of Verona; and before the ruins of the Coliseum one is astonished at the small number of penetrations involved by the continuous crossing of its innumerable galleries. To avoid penetrations, the Romans raised the springing of the vault of one gallery above the crowning of the vaults which it crossed; but while this solution presented no difficulty where it was applicable, a lack of height often made it impossible, and made the use of intersecting vaults unavoidable.

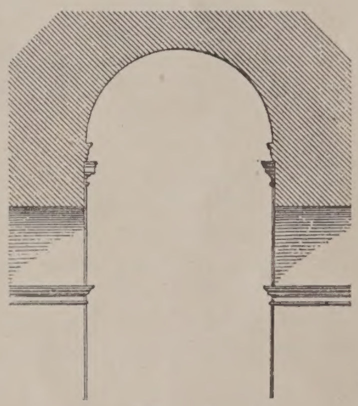


Fig. 38.

When the Romans had to vault, as was frequently the case, halls formed of a central nave flanked by two secondary ones, intersecting vaults were naturally used. In order to light the middle nave, there were only two possible methods, either to raise this vault high enough to obtain light through openings below the springing, or to make penetrations in the vault itself. The Romans ordinarily chose the second course, and it was in it that the groined vaults covering the great nave of the Basilica of Constantine (Plate III.) had their origin. It is for the same reason that groined vaults are to be found in the principal halls of the Baths of Caracalla (Plate V.), and in that most admirably preserved hall, which, in the sixteenth century, became the church of St. Maria Maggiore.

(*To be continued.*)

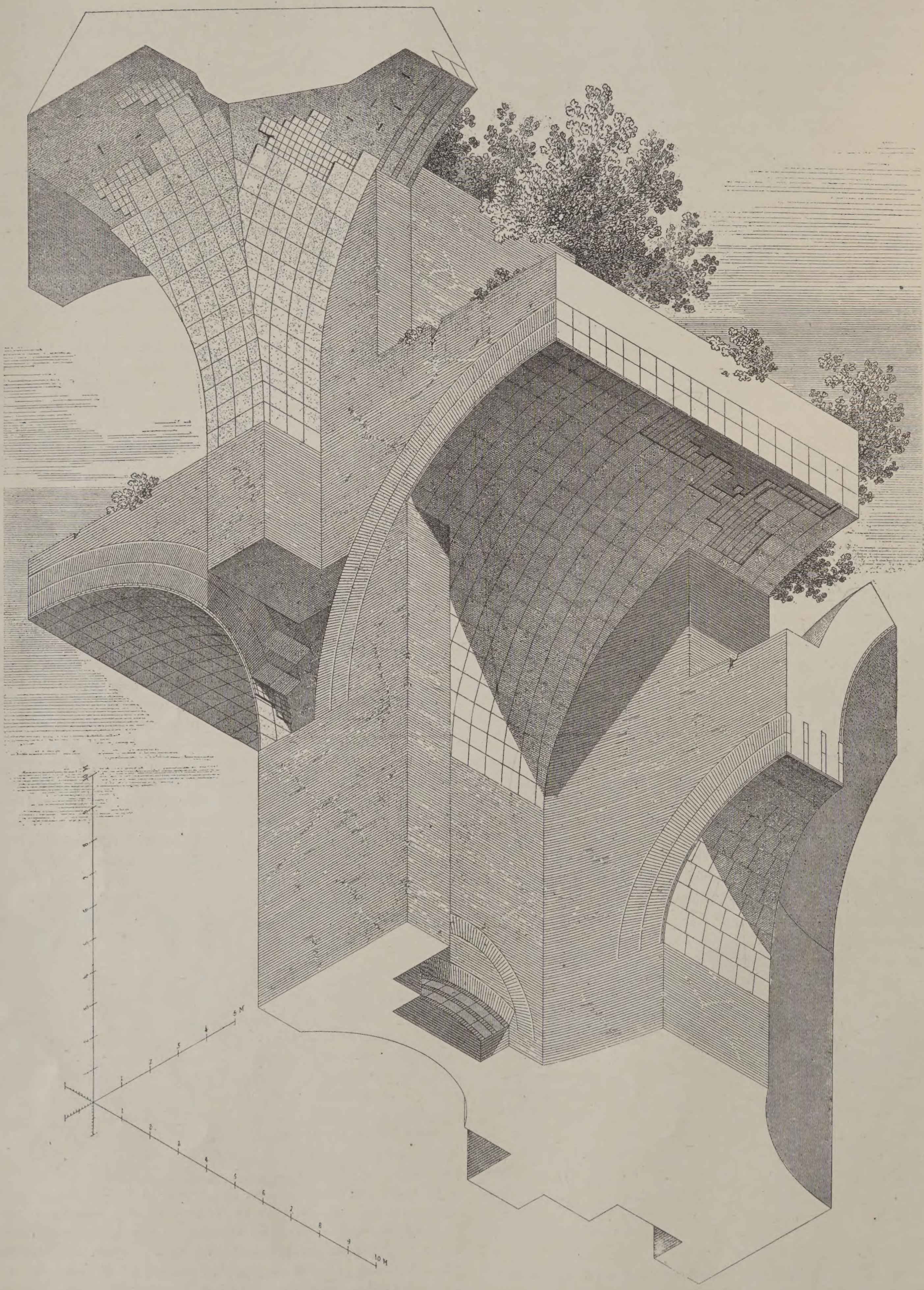


PLATE V. THE ART OF BUILDING AMONG THE ROMANS. (SEE PAGE 4.)

THE PEN-DRAWING OF BRICK ARCHITECTURE.

FIRST PAPER.

On reading over my last month's Brickbuilder I happened on a very flattering mention of myself, in the prospectus for the coming year, in connection with a series of papers which are to bear the caption, "The Pen-drawing of Brick Architecture."

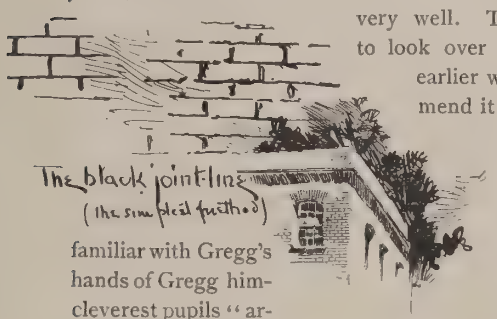
There is one word in that same prospectus to which I am ungracious enough to take exception, and that is, "entertaining." How, I ask, can one be entertaining on such a subject as the rendering of bricks? bricklaying is fun beside the rendering of them,—indeed the ordering up of a poor hod-carrier to the top of a high wall has something of the imperial in it, — but to take a pen and sprawl over a drawing-board while with infinite labour you draw in brick after brick is a very different thing.

No! that word "entertaining" grates a bit on my nerves; apparently I am cast for a funny man of some sort, and I am afraid the choice of subject will interfere with "my conception of ze part." Anyway, all the fun you may find will not, I promise you, interfere with the first intention of these papers, "The Pen-drawing of Brick Architecture."

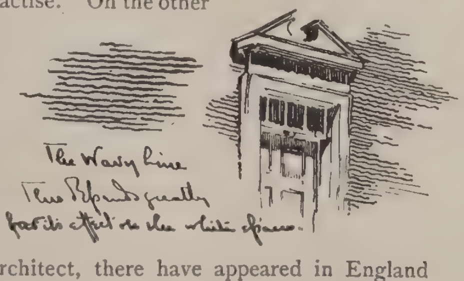
To begin with; for both our sakes, I earnestly hope and pray that the architecture you are about to tackle isn't too far away. There are only four or five men in America who can draw distant brickwork satisfactorily, and none or almost none in England. Even these few men are given to forgetting that such and such a palace or church or cottage is brick at all, and so with the aid of a spluttering toothbrush or lovely transparent shadows they produce something so beautiful that straightway you forget about the bricks too and are satisfied. But there! there! I'm not here to teach you tricks.

Brickwork can be drawn and drawn well, and satisfactorily to all concerned, though to tell the truth it's easier and less wearing on the patience of the draughtsman to render almost anything else.

Probably the first idea that will occur to the office boy, whose aspirations lead him brickwards, is to draw in with a black line all the joints, vertical and horizontal, and this sometimes serves its purpose very well. To prove it you have only to look over some of Joseph Pennell's earlier work. Yet I do not recommend it to any one unless he be of the highest ability, like Pennell himself.

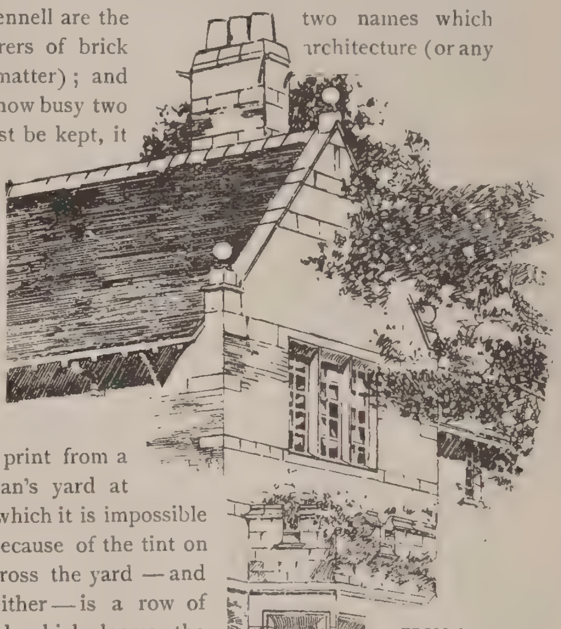

The black 'joint-line'
(the simplest method)

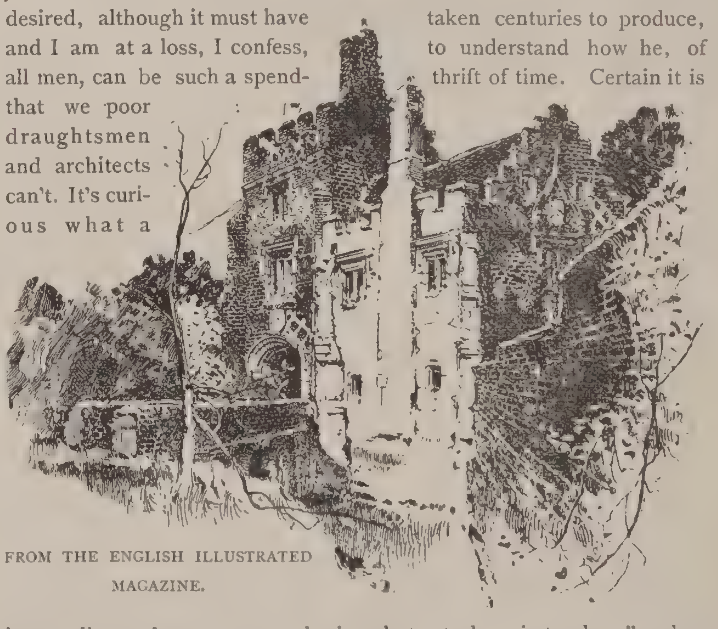
For distant work you are all of you probably familiar with Gregg's wavy line, which in the hands of Gregg himself and one or two of his cleverest pupils "arrives" delightfully; but this process looks easier than it is, for by far the greater number of those young ideas whom Mr. Gregg is teaching how to shoot only succeed in a very hard, mechanical imitation of his work, and none of them, unless we except Mr. Maginnis, have added anything of their own to the art they practise. On the other hand, however, many have brutalized all his methods until it is almost an insult to Mr. Gregg to recognize any echo of his own delightful handiwork.


The Wavy line
This depends greatly for its effect on the white spaces.

In the interval that has elapsed since I first apprenticed myself to an architect, there have appeared in England several men whose work is quite as good as our own, notably, Henry Wilson and C. E. Mallows. Wilson's work is wonderful, but do not attempt to follow it: you haven't time, for one thing, and for another, it is over the heads of the average client or committee as she is constituted in America. Mallows, however, is quite United States in style; and it is worth your while to notice the way in which he casts his shadows: not too severe parallel lines which invariably take the direction of the sunlight. This is a very ingenious dodge, in that it permits you to break up with little cloud-shadows and such like things big spaces of brickwork which it would be tiresome for you to cover, and tiresome for the beholder when so covered.

Railton and Pennell are the two names which come first as renderers of brick architecture (or any other kind, for that matter); and when one considers how busy two such great artists must be kept, it is surprising to find that of all draughtsmen they are probably the most careful and painstaking with their bricks. Witness this apparently rapid sketch of Buckden Towers by Railton. I have a copperplate print from a drawing of the Dean's yard at Westminster by him which it is impossible to reproduce here because of the tint on the plate. Away across the yard — and it is no little area either — is a row of brick houses, behind which looms the Abbey itself. In these houses he has drawn in the greater part of the bricks separately in solid black, in this same manner leaving the mortar joints white. The result is as near perfection as could well be desired, although it must have taken centuries to produce, and I am at a loss, I confess, to understand how he, of all men, can be such a spendthrift of time. Certain it is that we poor draughtsmen and architects can't. It's curious what a hurry clients always seem to be in; but "to hear is to obey," and so the most time-saving device is the best, though I have often seriously considered the propriety of having some one work, in cheerfully coloured worsteds on a perforated piece of cardboard the legend, "M. Angelo used up seven years on his set of drawings for St. Peter's, and made a failure at that," and then hanging it up in a conspicuous position in the office. It's a tempting scheme, but I suppose it wouldn't do.


FROM A DRAWING BY C. E. MALLOWS IN THE BUILDING NEWS.

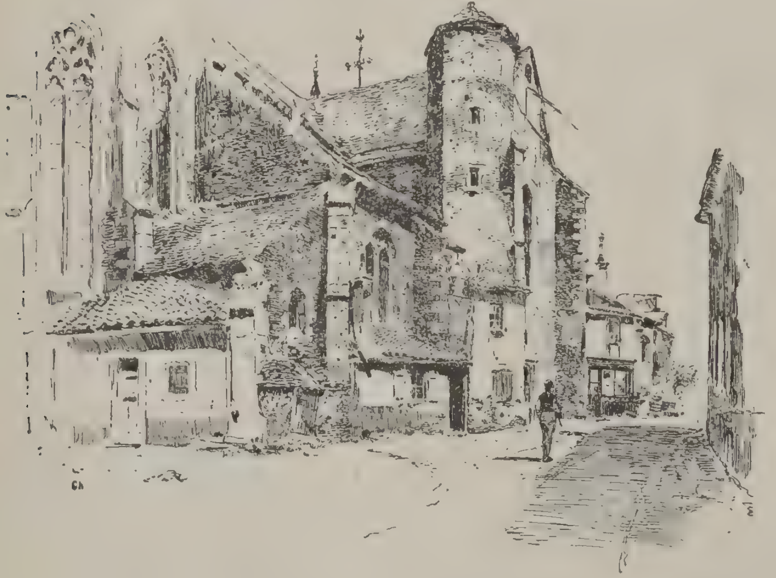

FROM THE ENGLISH ILLUSTRATED MAGAZINE.

However, there are a number of ways in which time may be saved, and the effect be as good, if not better, in consequence. In these papers I hope to show examples of the better class of work, as well as from time to time adding thumb-nail sketches of my own when I cannot find illustrations which explain my meaning as satisfactorily.

A few years ago, and it would have been an easy matter to give examples of all the good men, but of late the number of really excellent draughtsmen has multiplied tremendously, so I must content myself with but a few. Those of you who have read the first edition of

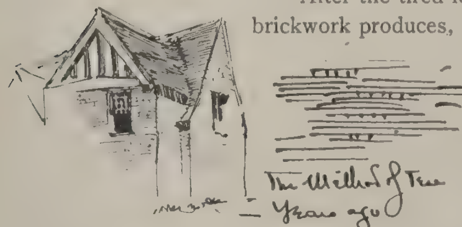
Pennell's monumental if somewhat narrow-minded book, "Pen-drawing and Pen-draughtsmen," will remember that he treated us all with but scant courtesy, mentioning favorably only Robert Blum and Beresford Pite, of whom the first is not an architectural draughtsman at all in the proper sense, and the other is an Englishman. But recently he has brought out a new edition, and here his stand is much more catholic. Why, he even gives Mr. Aubrey Beardsley quite a laudatory little chapter, besides printing one of Anning Bell's beautiful girls on his titlepage, — think of it! But with all his broadness, he can still see so little improvement in us that he doesn't even bother to rewrite or even to reprint his chapter on Architectural Pen-drawing. However, his elimination of it as it stood in the first edition may be taken as a sort of back-handed compliment. The truth is, I suppose, that he himself has such a pleasant pathway to tread in his own work, with his crumbling old Gothic cathedrals and white walled Italian towns, that he forgets that we are shambling along a byway of mushroom villas and cottages and what not, many of which have not yet appeared above the ground, (alas, how many of them never do!) or, at the most, for which the final certificate has but just been handed to the contractor.

And this brings me to another point. Perhaps Mr. Pennell is quite right after all, because it is lamentably true that but one in a thousand draughtsmen ever bothers himself to study directly from nature, or, granting that his intentions are good in this respect, he has little time to do so.

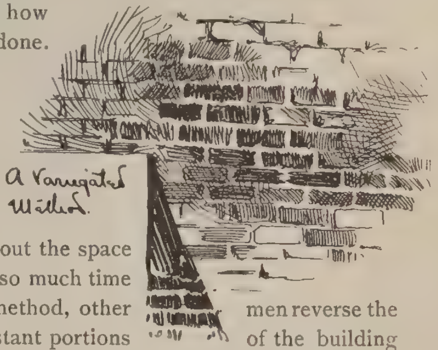


DRAWN BY JOSEPH PENNELL FROM A "SUMMER VOYAGE," THROUGH THE COURTESY OF ROBERTS BROS.

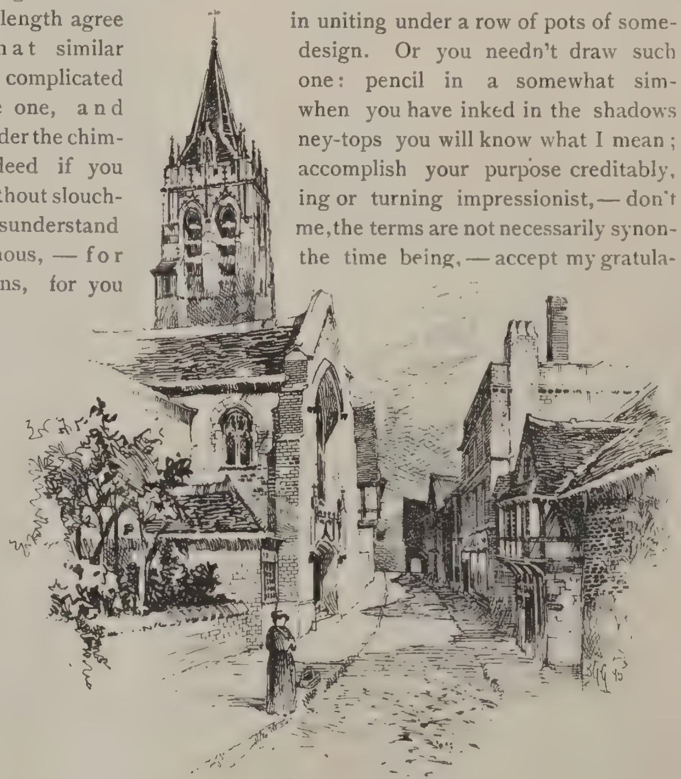
I'll wager that all the sketching from nature most of our very best men have done has been on their little poverty-stricken, hurried, and generally third-class-compartment European tours, for which they have saved for years, and have to see so much that they haven't time to draw. Some of us have never had even that "desert in our oases," as they say in "The Green Carnation," and so it is little wonder if we fall into a habit of setting imaginary types of things in the place of the things themselves, — type trees, type grass, type mountains, type brickwork, and, worse than all the rest, type beings, — I can't bring myself to write human beings, — type writers, type everything, — the Lord have mercy on us all!


The Method of Ten Years ago

After the tired feeling which the drawing of brickwork produces, probably the difficulty of covering large areas of blank wall without dulness or insipidity is the greatest drawback to success. In the work of a dozen years ago nobody appeared to feel this, and so they covered their big spaces like little men, with long and short stupidly horizontal lines, sometimes — though this was but rarely, and only the hardiest spirits attempted such feats — they clawed away, and with little nervous digs of the pen point suggested — save the mark! — a limited number of the vertical joints. Now, however, as I have said, we have changed all that, and any draughtsman with even the rudiments of imagination can think of things which will serve to break the monotony. Of course, to leave the white paper is one of the best expedients, and if this is done in just the right way nobody will know the wall isn't there. I can't tell you how to do it, only that it can be done. My own practice is to leave white the nearest part of the sunlit side of the building I am at work upon, at the same time giving so much more than the usual amount of attention to the shadows about the space that it is questionable if I save so much time after all. While I prefer this method, other men reverse the process by lighting the more distant portions of the building and intensifying the shadows there.



The next difficulty which comes to me is in complicated work, moulded brickwork, shadows from delicate pieces of detail, etc. To appreciate this you have only to draw a chimney-top with considerable projection. Think of some of those which Kirby is so fond of using, where three or four twisted and turned shafts at length agree in uniting under a row of pots of somewhat similar design. Or you needn't draw such a complicated one: pencil in a somewhat simple one, and when you have inked in the shadows under the chimney-tops you will know what I mean; indeed if you accomplish your purpose creditably, without slouching or turning impressionist, — don't misunderstand me, the terms are not necessarily synonymous, — for the time being, — accept my gratulations, for you bid fair to make a successful draughtsman. Another difficulty is to draw with any degree of care without having the brickwork so drawn black out of all proportion to the rest of the sketch. So that while Railton's drawing of the Dean's yard at Westminster is drawn in this fashion, it is because he meant it to be dark and shadowy at this very spot. Inasmuch as the whole thing is in a very low key, the foliage in particular being quite as dark as the row of houses, it is probable that he was endeavoring to obtain the effect of the proverbial London atmosphere. Thank goodness we architectural men don't have to give much of our time to obtaining atmospheric effects in our work! Think of a *vibriste* or a *gris en gris* draughtsman! Eh?



A FREE USE OF THE BLACK JOINT LINE.

BERTRAM G. GOODHUE.

RECENT BRICK AND TERRA-COTTA WORK IN AMERICAN CITIES.

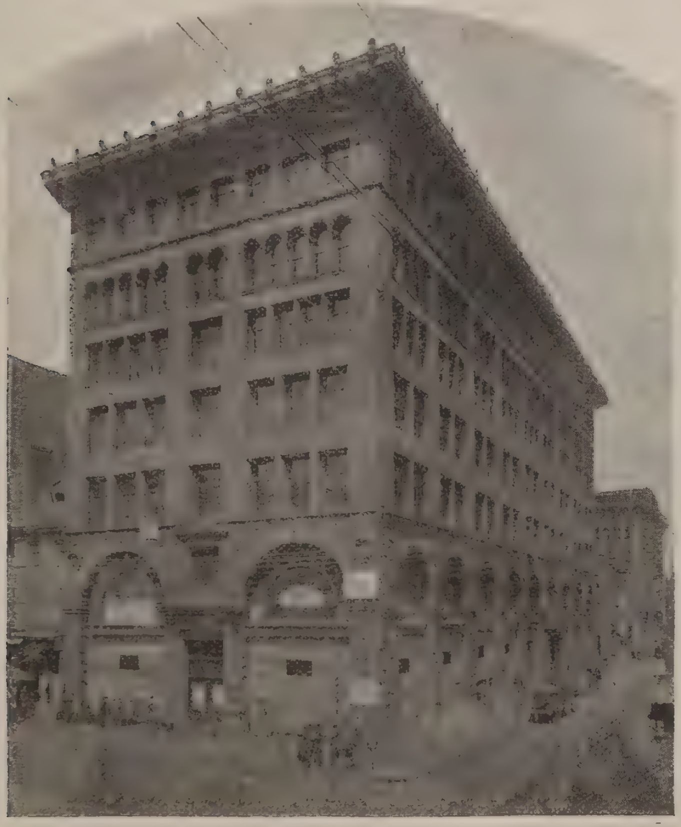
TERRA-COTTA FIGURE IN HIGH RELIEF.
ODD FELLOWS' TEMPLE.
Executed by the Perth Amboy Terra-Cotta Co.

PHILADELPHIA.

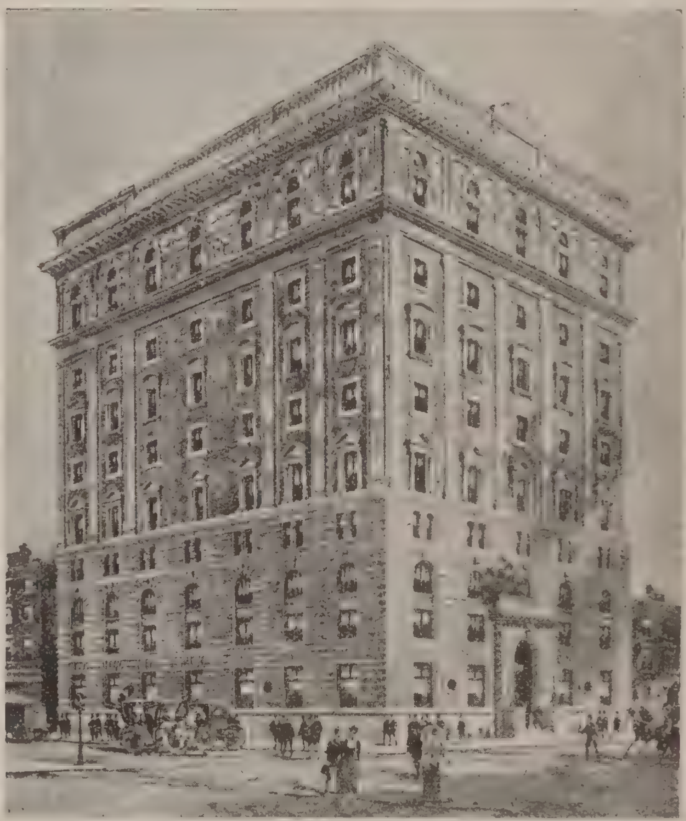
STORE BUILDING CORNER OF TENTH AND MARKET STREETS.

THE building is divided horizontally into a base, including the two lower stories, — the main body, which takes up four more, — and the entablature, which includes the seventh story. Naturally, the treatment of the base is as horizontal as possible, in order to satisfy the eye. But it is to the main part of the building — that is to say, the four stories over the round arches — that we wish to call attention. A very common and very obvious thing to do in a design of this kind is to use up all the wall space by pilasters, or shafts, or columns, whole openings between them being window spaces. A very unfortunate effect of this is to produce the impression on the eye of an immense vertical thrust, which thrust seems by no means satisfactorily carried on the light and open base. It is in vain that the designer decides to dispense with any such vertical treatment so long as he places the windows in their natural constructive position; that is to say, one directly over another and of the same size. The effect of the vertical line of masonry is still there. It has, therefore, occurred to us to use a motive very common in the Italian brick towers, of making the width of the windows of each story a little greater than those immediately below. The vertical sides of the opening formed by all the windows thus seem to converge toward the bottom, which naturally produces the illusion that the sides of the tower converge toward the top more than they actually do, and gives, as everybody knows, an effect of lightness and strength. In this design we have tried the adaptation of this principle in repetition on a long wall, and we think we can say, that without doubt, in looking at the building, in reality it gives the impression of a homogeneous wall instead of a succession of isolated piers. The wall, unquestionably, looks lighter, and at the same time stronger, than if the openings had been all of them of the same width. The height of the windows and the vertical wall space between them have also been diminished towards the top. On the whole, the experiment is reasonably satisfactory, and in the design of the terra-cotta building now in course of construction, which will be shortly published in THE BRICKBUILDER, we hope to show that the same idea may have still better results in a higher building than this, especially when the mouldings around the windows in all the stories are kept exactly alike, and when the outside wall itself has a slight entasis.

COPE & STEWARDSON, *Architects*.



STORE BUILDING, CORNER TENTH AND MARKET STREETS.

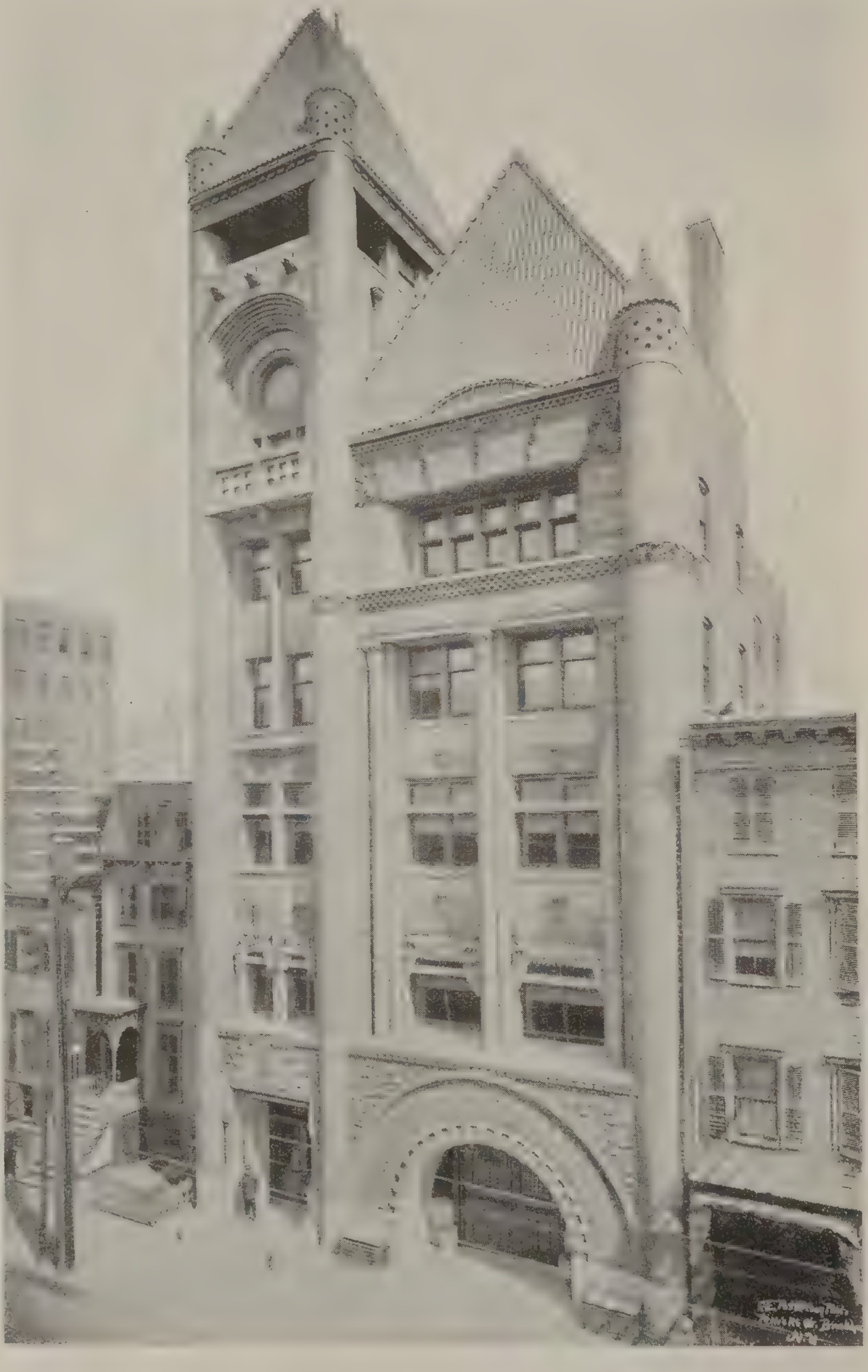


ODD FELLOWS' TEMPLE,
BROAD AND CHERRY STREETS, PHILADELPHIA.

THE building is nine stories high, one hundred and twenty feet on Broad Street, and one hundred and seventy feet deep on Cherry Street. It is considered to be one of the handsomest buildings in Philadelphia, built of cream-colored Roman brick of Eastern Hydraulic make, and terra-cotta white in color made by the Perth Amboy Terra-Cotta Company.

The arched entrance is twenty feet wide by thirty feet high, with a vestibule twenty by twenty feet, which opens into the grand court and stair hall, to the rear of which is the auditorium, forty feet high, sixty-six feet wide, and nearly one hundred feet long, free of columns. The second, third, fourth, and fifth floors will contain offices, there being over one hundred in all. The upper floors contain lodge-rooms, encampment rooms, and banqueting hall, etc.; drill-room in basement. Flooring is of steel girders, with terra-cotta floors and partitions; fireproof. J. E. & A. L. Pennock, builders; Hazlehurst & Huckel, architects.

MUCH attention is now paid to methods of fireproofing the steel skeletons of buildings erected at the present time, especially in the case of structures intended for public purposes. A notable illustration of this feature is presented in the treatment of the great girders of the new Tremont Temple in Boston. The steel girders are first placed in terra-cotta blocks, on all sides and below, these blocks being then strapped with iron all around the girders, and upon this is stretched expanded metal lathing covered with a heavy coat of Windsor cement; over this comes iron furring, which receives a second layer of expanded metal lath, the latter, in turn, receiving the finished plaster. There is consequently, in this arrangement for fire protection, first, a dead-air space, then a layer of terra-cotta, a Windsor cement covering, another dead air space, and finally the external Windsor cement. These great girders are characterized as the vital parts of the whole steel structure, the necessity of their absolute protection being explained by the fact that a rise in temperature of 300° would throw the columns out of place about an inch and a half on each side, and a rise of about 500° would ruin the steel. Another feature to be noted in this work relates to the partitions of the outside corridors about the auditorium, these being built of terra-cotta blocks, held securely in place by means of angle irons, and bound together by expanded metal lathing on each side, upon which is placed the plaster.


HEADQUARTERS OF THE BROOKLYN FIRE DEPARTMENT.
FRANK FREEMAN, ARCHITECT.

THE FIRST NATIONAL BANK of New Haven, Conn., are erecting a handsome office building which will be modern in every particular — brick exterior, steel construction, and fireproof. L. W. Robinson, architect.

THE new catalogue of The Central Press Brick Company of Cleveland is certainly a most artistic affair, and its mission, as stated, "to give a faint idea of the possibilities that can be obtained from the artistic use of pressed brick," is well accomplished. There are some forty sketches of different styles of mantels, with description beneath each sketch. The designs of these vary considerably, and it would seem that with such an assortment to select from it would not be difficult to find a design to one's taste. We consider some of the mantels very excellent in point of artistic construction, and congratulate the company on the publication of so attractive a pamphlet.

THE extensive use of enamelled brick in the dynamo rooms in the sub-basement and the twenty-two treasury vaults located in the New State House is evidence of their value as light reflectors, fireproof qualities, non-conductors of moisture and odors, and durability. This is the practical phase of the matter in a nutshell. The artistic features of the Somerset enamelled brick are also worth looking into. Here are some beautiful examples of these mellow white brick, so rich in lustre, so deep and pure in tone, and so receptive in color that one could live in a room whose mural finish was composed of just such agreeable material. To the eye — and for that matter, architects and those who have used these bricks extensively assert their equality in all points with the imported — they are wholesome adjuncts in interior decoration, rather adding to than detracting from the designer's or colorist's art, — a point worth considering in the adornment of residences, offices, public or monumental buildings. It is pleasant to note that Architect Brigham has so favorably indorsed this material by its use in the State House, thus extending its popularity and admitting it to be adapted for almost endless uses. The fireplaces, arches, or like localities where catchy angles or curves are to be used, find in the material an accommodating medium, and the advocacy of its use in school halls, corridors, and sanitaries is timely.'— *Boston Herald.*

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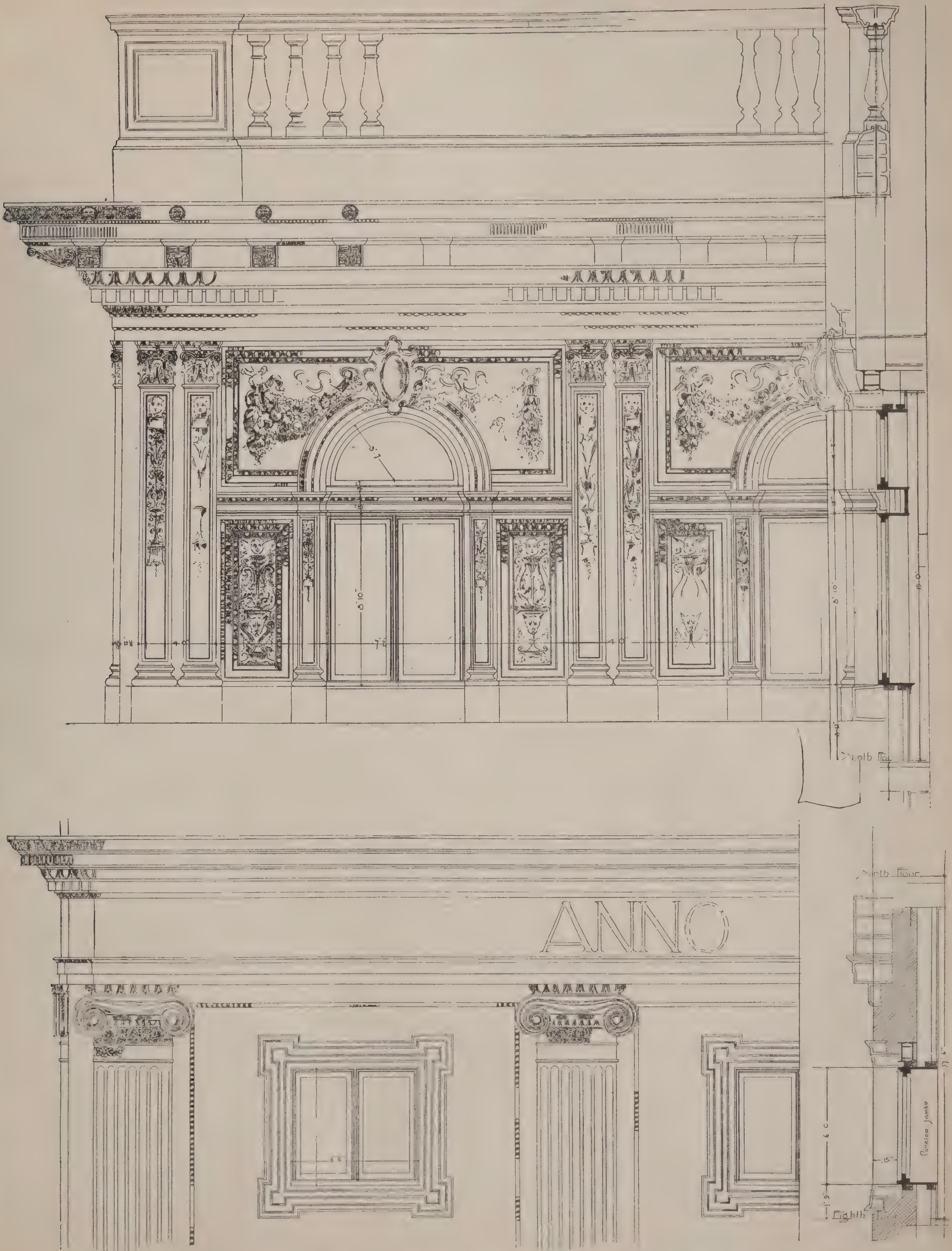
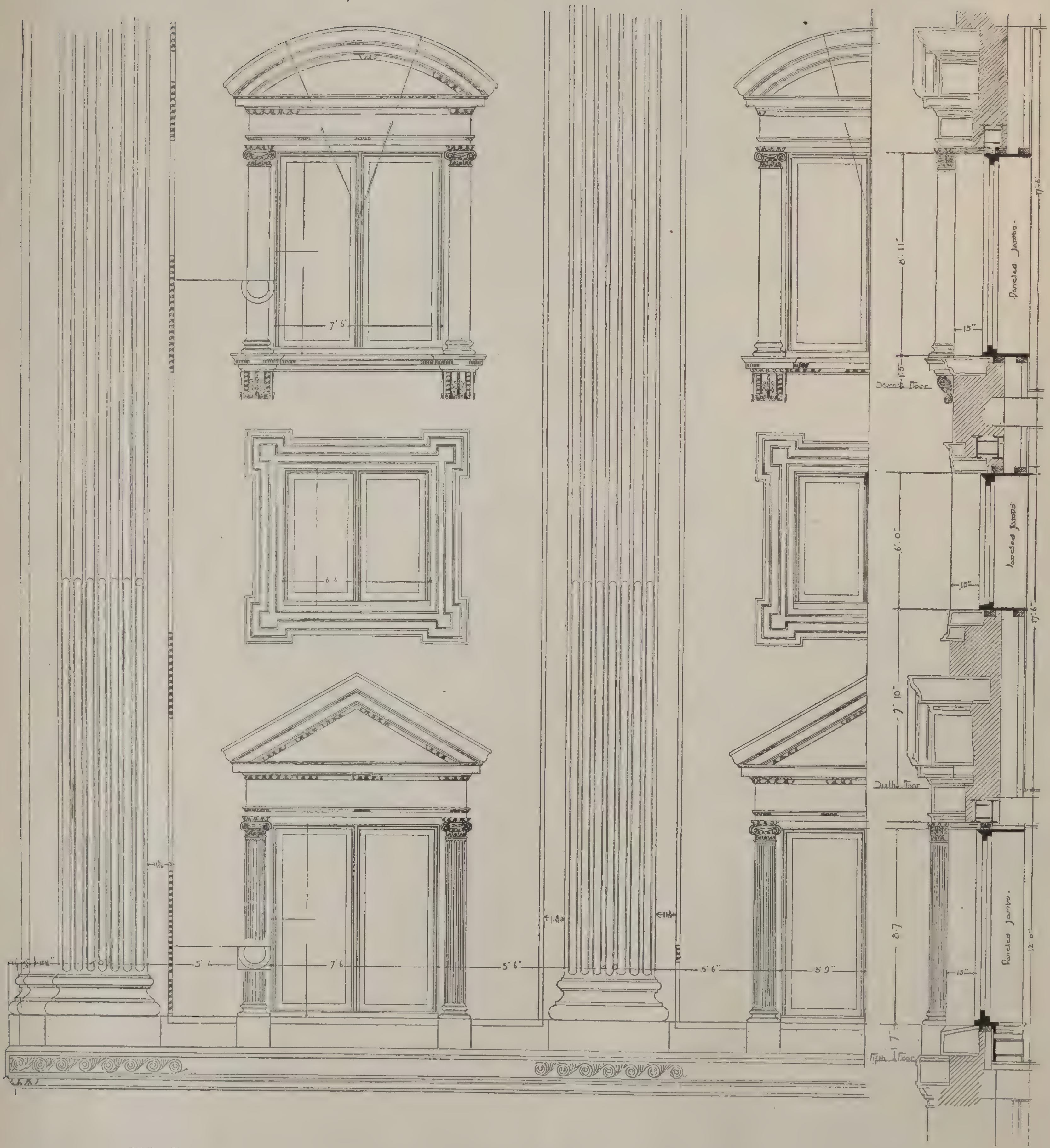
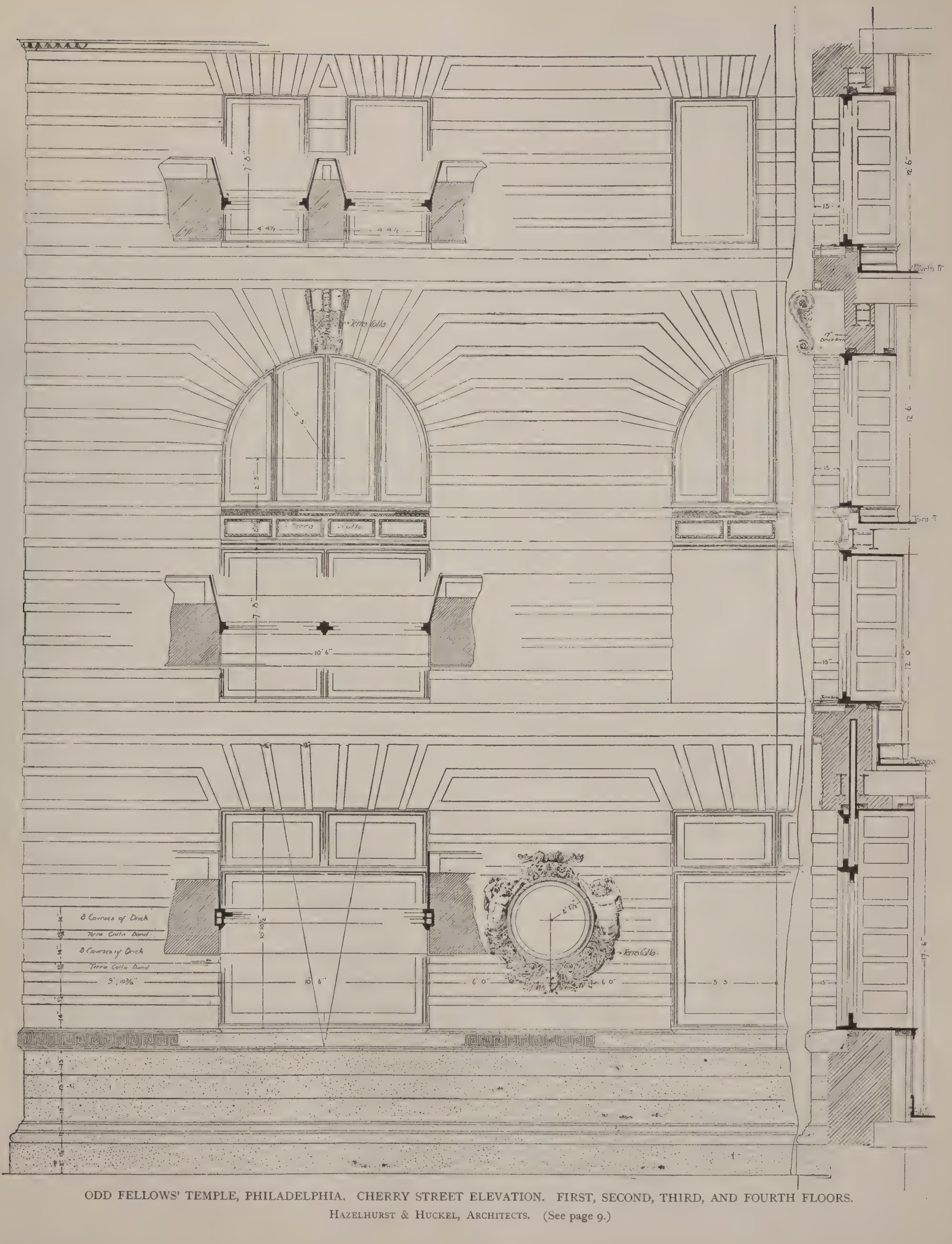


ODD FELLOWS' TEMPLE, PHILADELPHIA. UPPER PART OF CHERRY STREET ELEVATION.
HAZELHURST & HUCKEL, ARCHITECTS. (See page 9.)



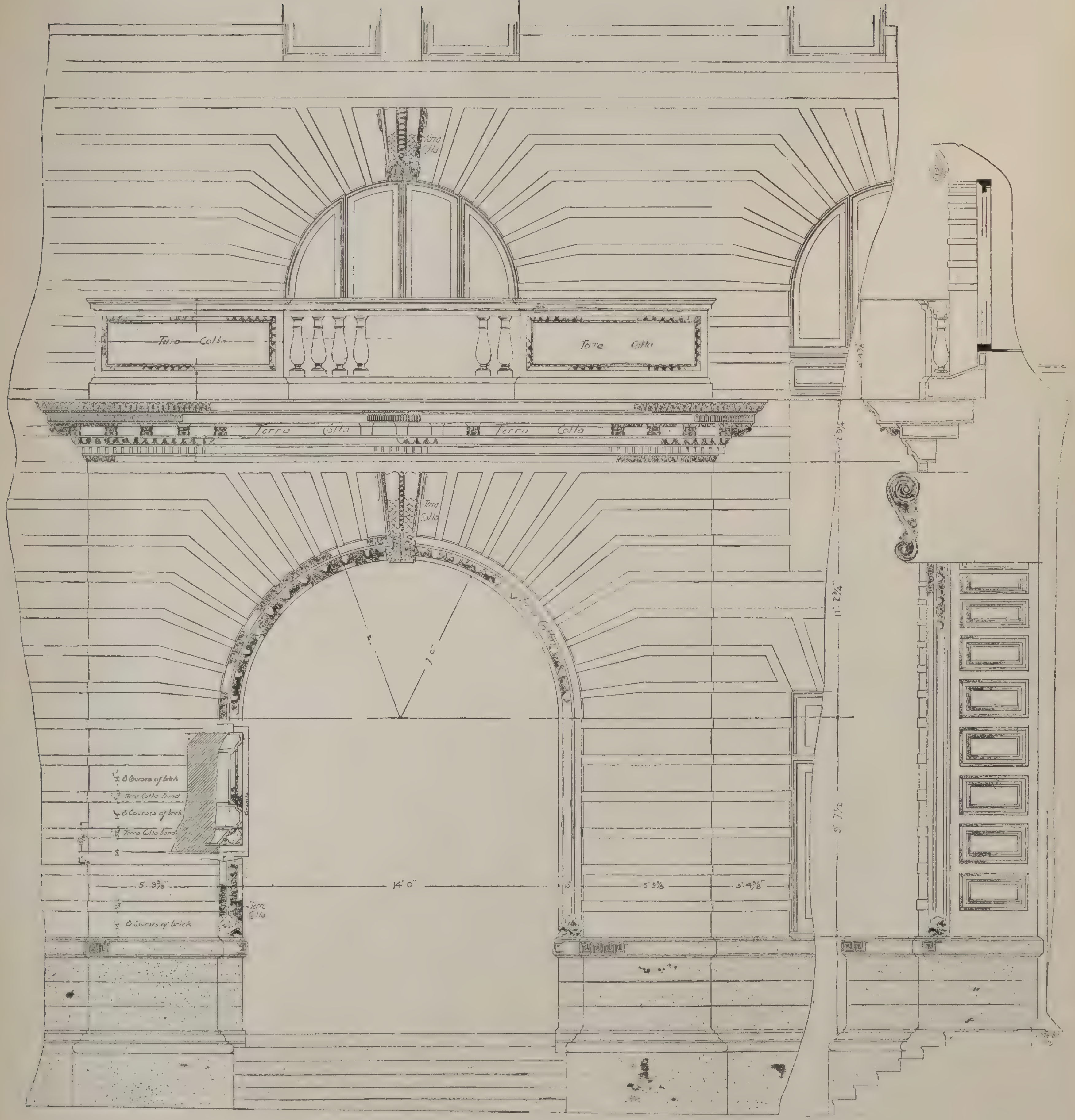
ODD FELLOWS' TEMPLE, PHILADELPHIA. CHERRY STREET ELEVATION. FIFTH, SIXTH, AND SEVENTH FLOORS.

HAZELHURST & HUCKEL, ARCHITECTS. (See page 9.)



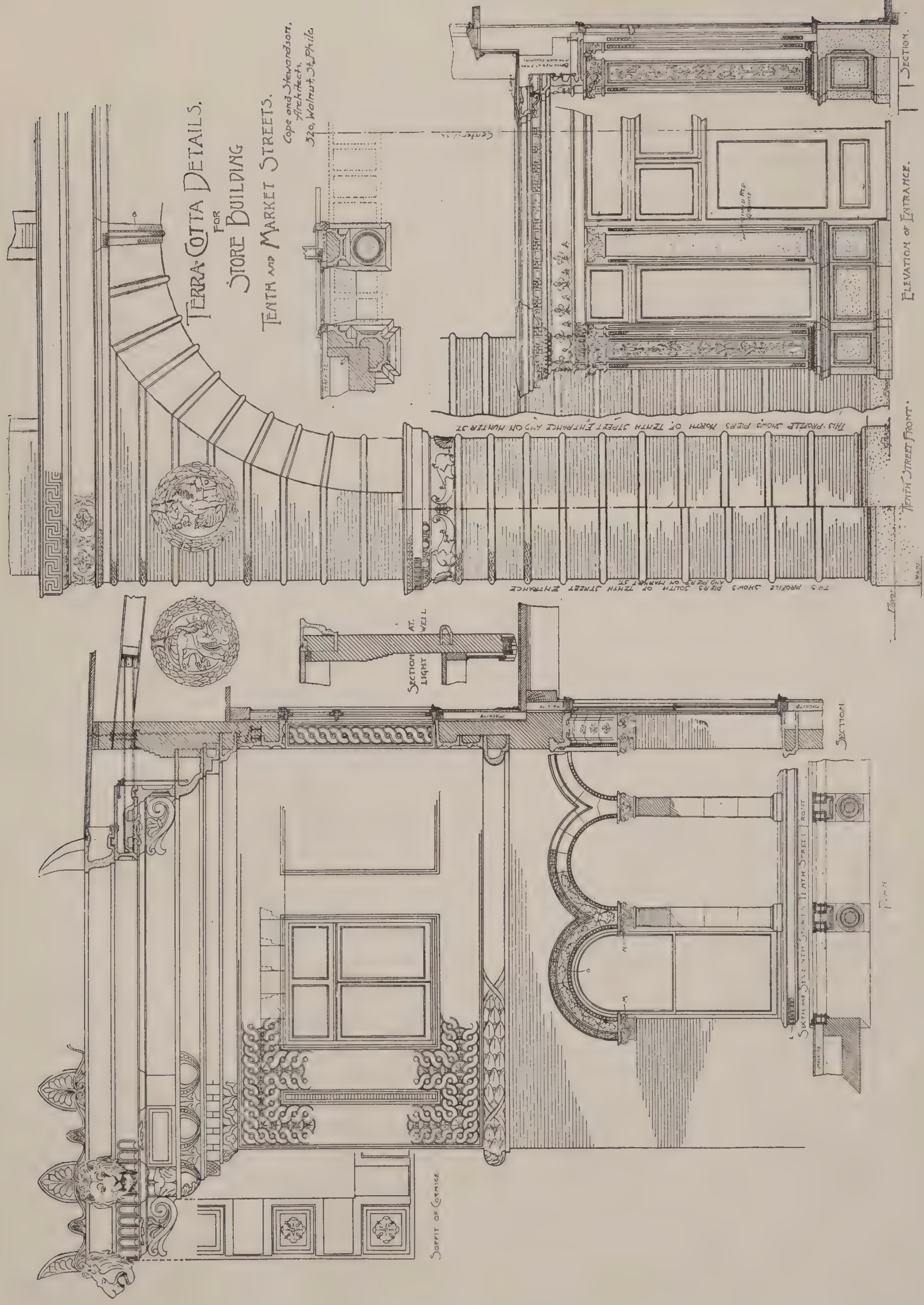
ODD FELLOWS' TEMPLE, PHILADELPHIA. CHERRY STREET ELEVATION. FIRST, SECOND, THIRD, AND FOURTH FLOORS.

HAZELHURST & HUCKEL, ARCHITECTS. (See page 9.)



ODD FELLOWS' TEMPLE, PHILADELPHIA. CHERRY STREET ENTRANCE.

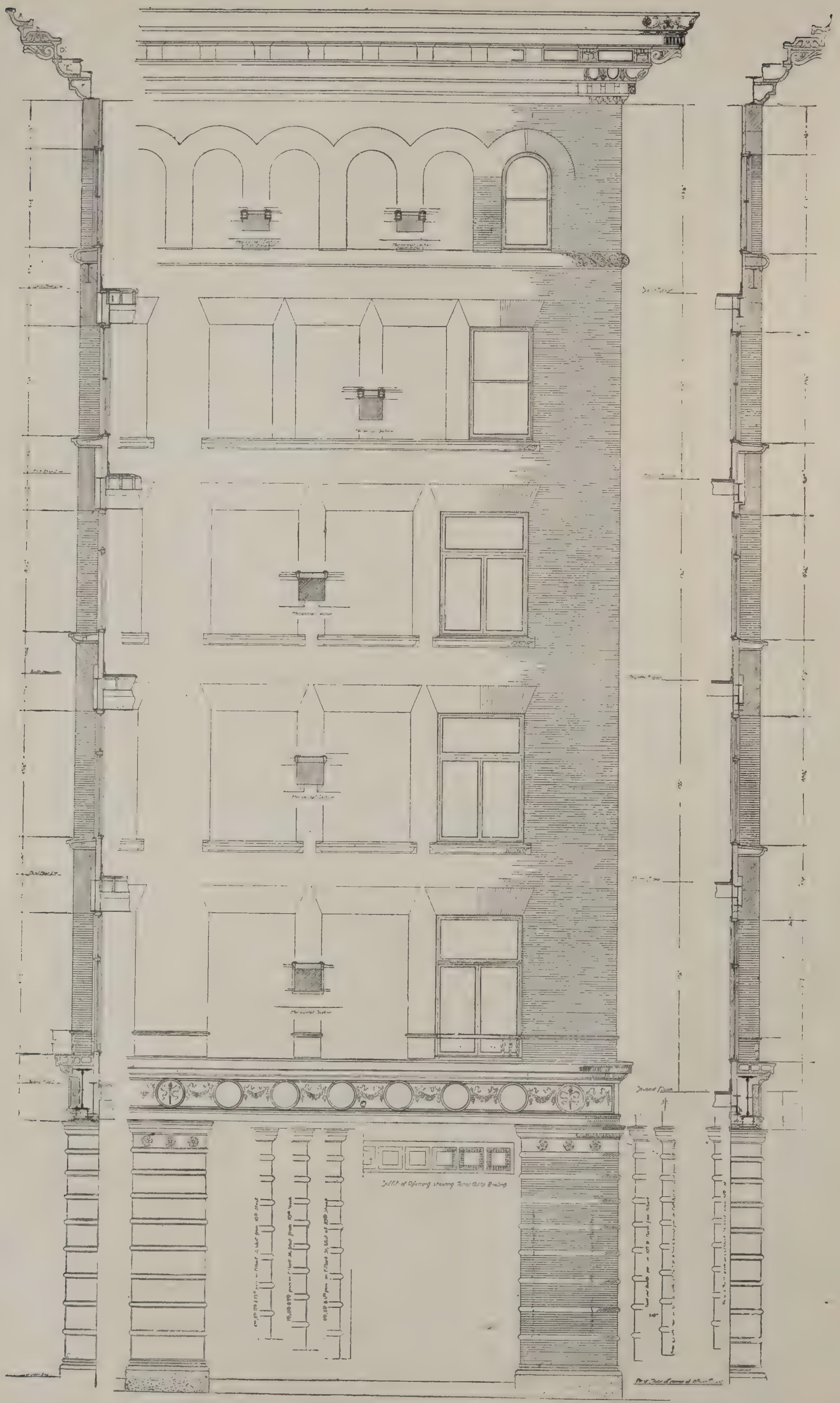
HAZELHURST & HUCKEL, ARCHITECTS. (See page 9.)



TERRA-COTTA DETAILS.
FOR
STORE BUILDING
TENTH AND MARKET STREETS.

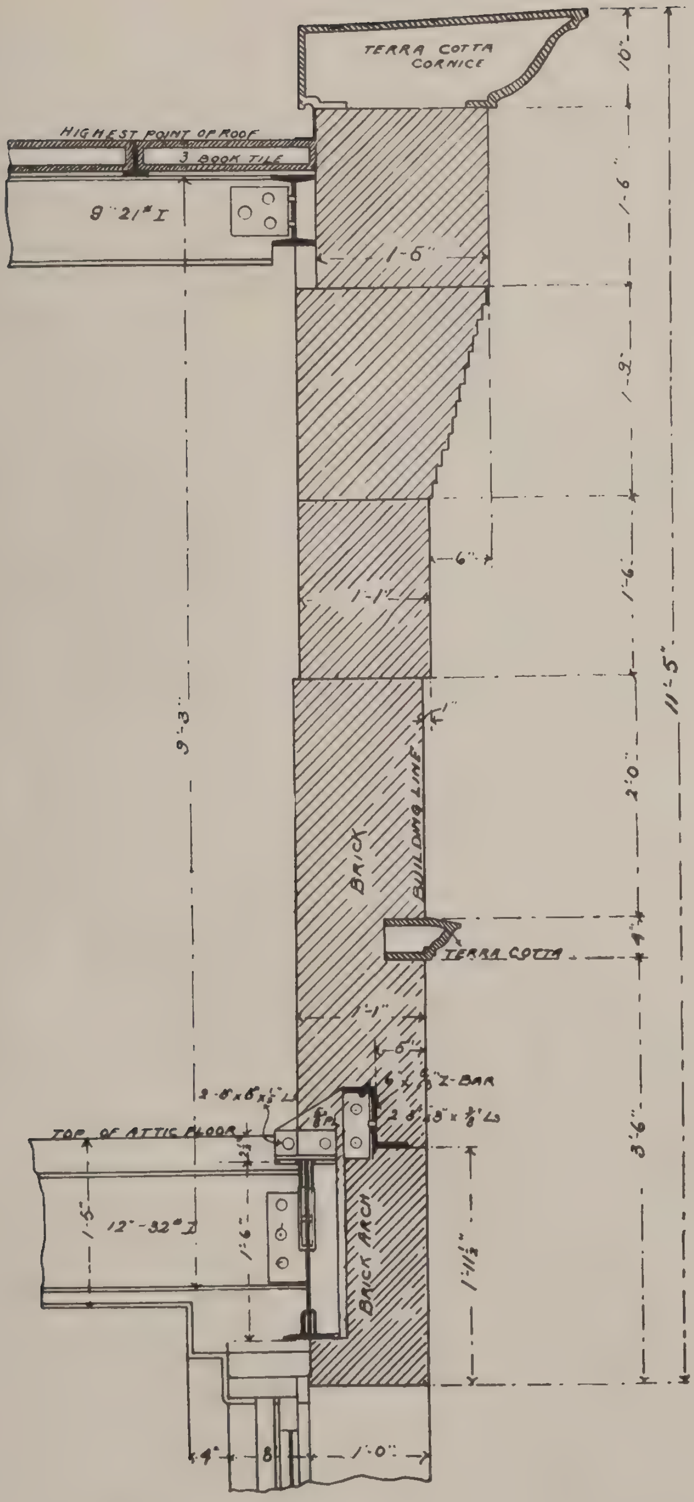
Cope and Stewardson,
Architects,
320, Walnut St, Phila.

Section.
Elevation of Entrance.
This profile shows piers north of Tenth Street entrance and on Hunter St.
This profile shows piers south of Tenth Street entrance and piers on Market St.
Tenth Street Front.
Grade
Floor
Section Light Well
Section
Sixth and Seventh Streets Tenth Street Front
Soffit of Cornice

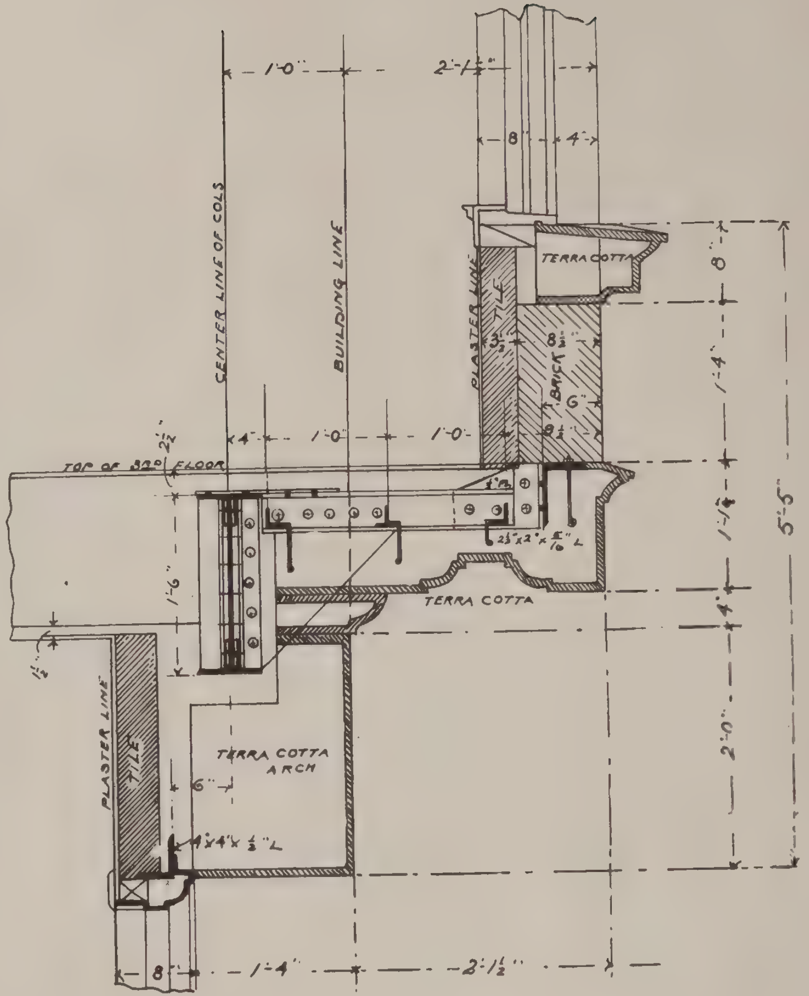


ELEVATION OF CORNER BAY ON FILBERT STREET, PHILADELPHIA. STORES FOR C. C. HARRISON, ESQ.

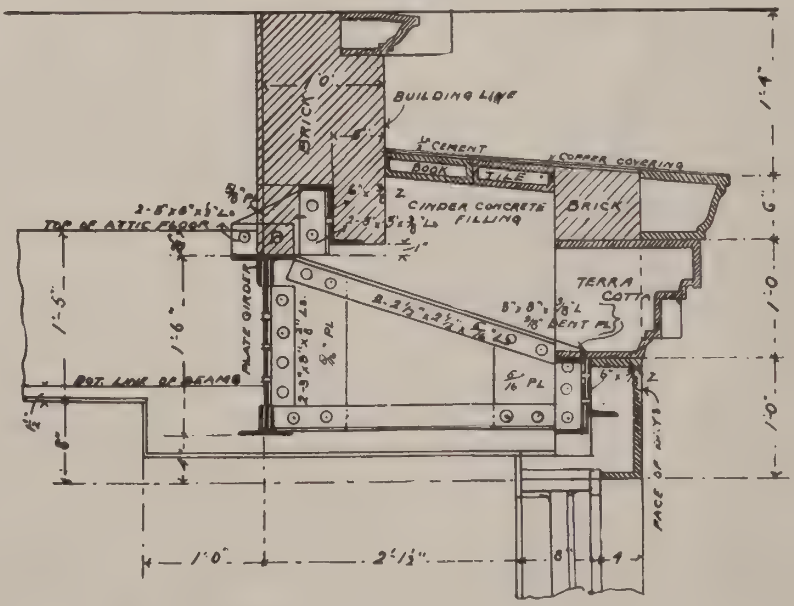
COPE & STEWARDSON, ARCHITECTS. (See page 9.)



SECTION THROUGH ATTIC



SECTION THROUGH BOTTOM OF ALL BAYS 3RD FLOOR.

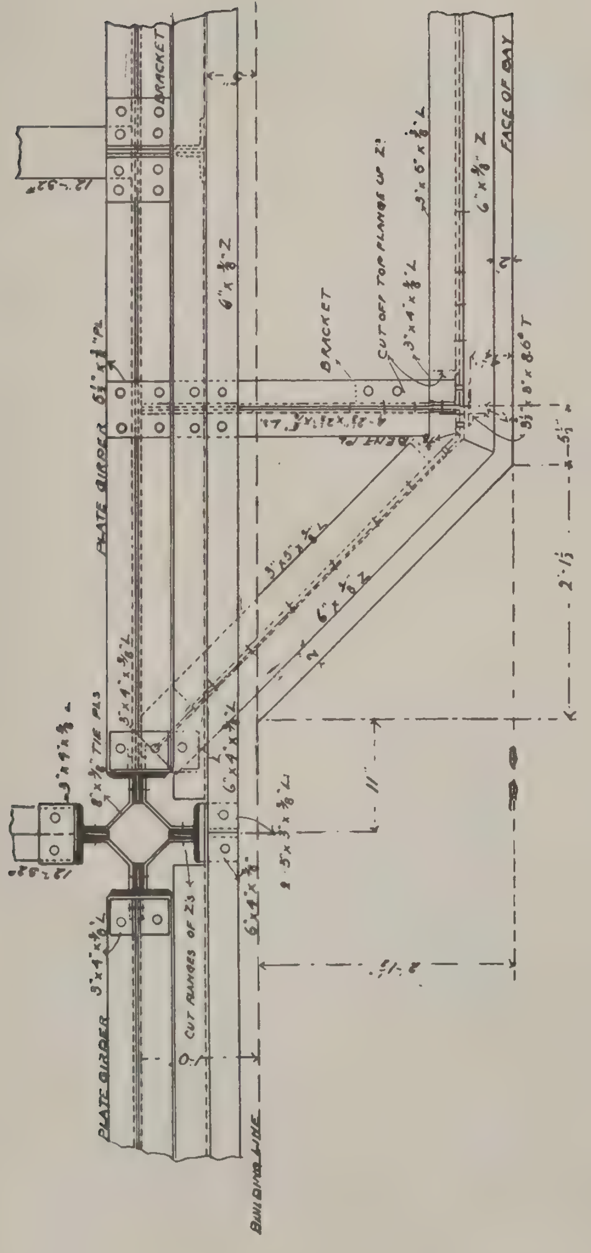


SECTION THROUGH TOP OF BAYS

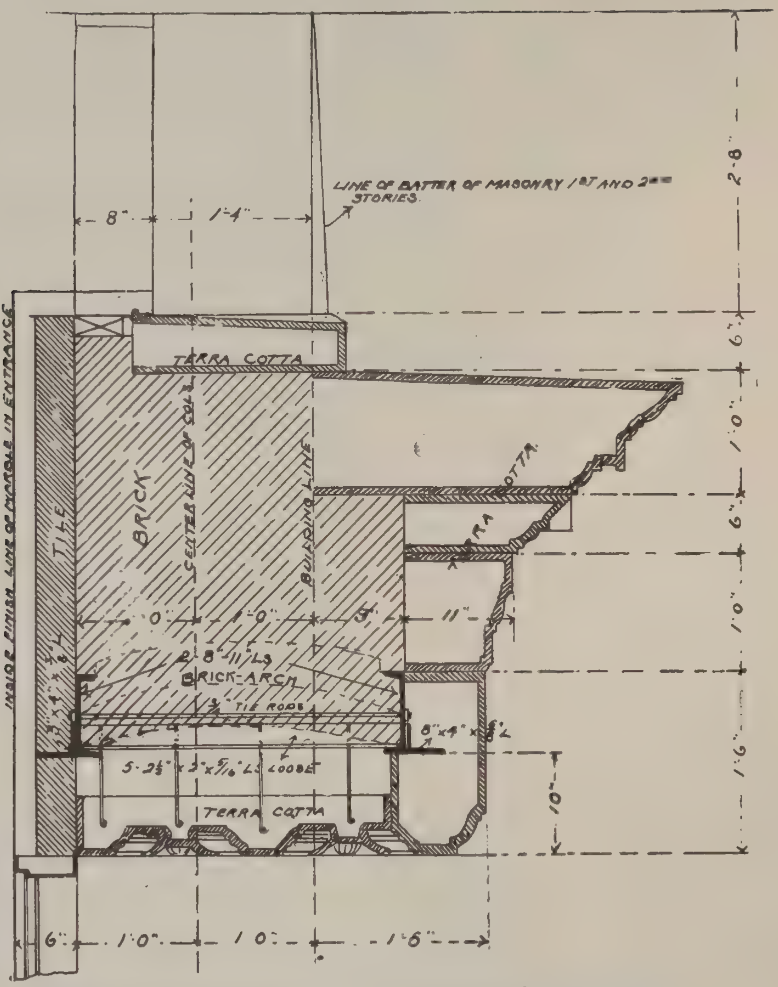
WYANDOTTE BUILDING.

SCALE 0 6 12

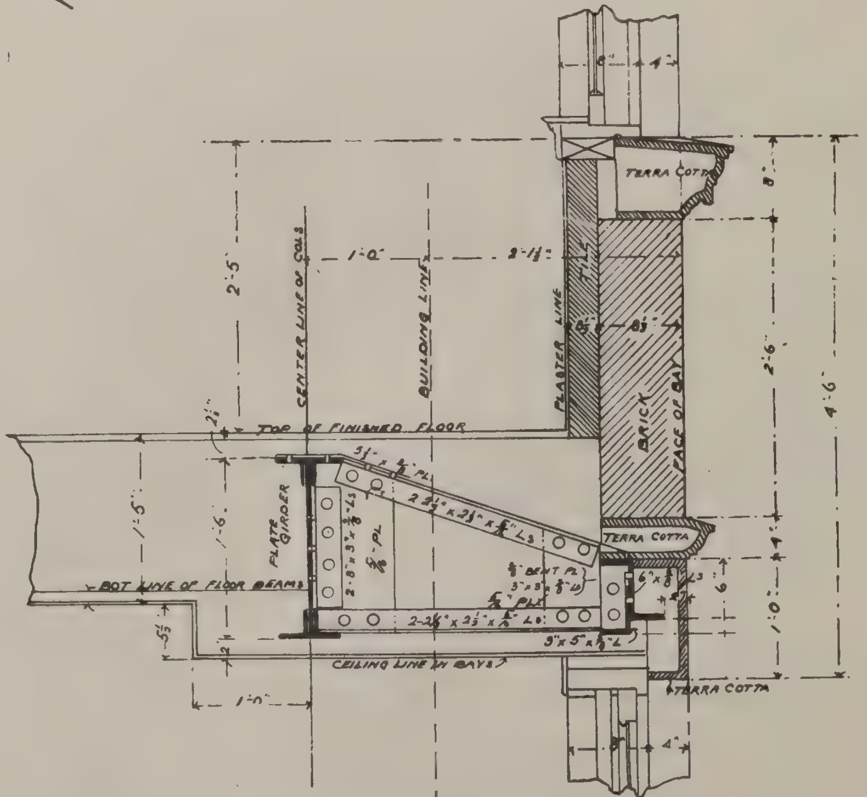
DETAILS OF FIREPROOF CONSTRUCTION. (See page 13.)



PLAN OF BAYS



SECTION THROUGH TOP OF ARCH NORTH ELEVATION
MAIN ENTRANCE



SECTION THROUGH ALL BAYS 4TH TO 11TH FLOORS INCLUSIVE

WYANDOTTE BUILDING.

SCALE 0 6 12 IN.

DETAILS OF FIREPROOF CONSTRUCTION. (See page 13.)

THE BRICKBUILDER.

AN ILLUSTRATED MONTHLY DEVOTED TO THE ADVANCEMENT OF ARCHITECTURE IN MATERIALS OF CLAY.

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A COLOR TREATMENT OF TERRA-COTTA.

AMERICAN architecture is notable for the almost total absence of the accidental. Architecture has been carried in this country to a point where it exhibits in many instances most careful study, but we have not yet been able to unite a scholarly study of design with the accidental touches which are found so charming in connection with the work of older peoples. It is difficult to deliberately simulate such accidental effects even by the most careful study, because, after all, the happiest features of this sort are so purely the result of hazard and of the weather. As far as relates to pure design, the accidental as an adjunct of architecture is, on the whole, to be deplored, but when the consideration of color is involved— and it is a consideration which cannot be entirely disassociated from any architectural conception — it is to the accidental that we look for our happiest effects.

Of late years terra-cotta has become by natural selection the most promising medium with which to experiment in color for external effects. The temptation to use colored terra-cotta is a strong one, but the uncertainty of the actual results has made nearly all of the attempts very timid and halting in their character. The impossibility of change after the material is once set, and the difficulty of judging the effect until the whole is in position, complicate the problem to an unusual extent. Any attempt therefore to adapt colored terra-cotta to the design of a building is always of interest.

IN designing the exterior of Tremont Temple, Boston, the architects, Messrs. Blackall and Newton, have aimed to make color a very essential and predominating feature of the design. The principal portion of the façade, extending through a height of about fifty-two feet and a width of ninety feet, is an almost unbroken wall surface, and is faced entirely with terra-cotta blocks about 5¾″ x 11″, disposed in a diagonal zigzag pattern something after the style of the exterior walls of the Doge's Palace at Venice. In the Venetian example these blocks are of marble mottled by time and weather in a great variety of hues and yet blended in a delightful manner, so that while the pattern is quite apparent the general effect is not disturbed. In a modern building there would be several possible color treatments of a pattern of this nature. The most simple and possibly the safest would be to employ at the most three harmonious shades of the same color, alternating them sufficiently to accentuate the pattern while not permitting a great variation in tones. This might give a soft, pleasing effect, but could hardly be called color. Another treatment would be to use two or three contrasting colors repeated at regular intervals like a stencil. This has been tried in a very conspicuous New York church, which, as an unfortunate result, has acquired the sobriquet of "The Church of the Holy Oil Cloth."

NEITHER treatment has been followed in Tremont Temple. The front has been considered as a whole, and an attempt made to reproduce to a certain extent some of the accidental qualities which lend such a charm to the Doge's Palace. Fifteen distinct colors of terra-cotta are used, ranging from almost pure white through buffs, pale browns, deep red, and grays, to a medium green. These colors were not disposed in any regularity over the surface, but in designing the work the entire front was first studied on paper in the actual colors, and the blocks grouped so as not only to bring out the pattern but also to vary and modulate the whole scheme, so that, starting with grayish tones at one lower corner, and with pink tones at the other, the front merges gradually into lighter or more pronounced tones at one upper corner, and fades into pale buffs at another. This is an effect which is simply impossible to describe, and is also impossible to lay out fully on paper in advance. Consequently, after the color studies were carried as far in the office as possible, the actual blocks were laid out full size on the ground at the terra-cotta works at Perth Amboy, each block being put in position, shifted, transposed, or rearranged, until the desired effect of contrast, gradation, and harmony seemed to be perfectly satisfactory.

The work was first so laid out on a clear, bright day, and was subsequently reviewed on a cloudy day, as well as immediately after a rainstorm, and as the rain changed the values of every color used in the terra-cotta, when the colors were wet many changes suggested themselves. The blocks were finally arranged in what seemed to be the best manner, were then numbered, and shipped to Boston, where, during the whole process of erection, they are carefully watched by the architects, and such corrections in color made from time to time as are suggested by inspection in place. In other words, this portion of the front is treated precisely like a huge mosaic, every one of the ten thousand blocks being studied both beforehand and in place in its relative and absolute values so as to produce a surface which shall be a harmonious whole.

The pattern work is framed in a broad band of white modelled terra-cotta on each side and across the top. The two stories above the diaper work, also the details about the few window openings in this work, are executed in white terra-cotta, and the masonry of the two stories immediately below it is of soft-toned Indiana limestone closely matching the colors of some of the terra-cotta facings. The blocks are all laid up in white lime mortar. The effect of the white joints will undoubtedly be a little staring at first, but the lime will blacken so quickly with the atmosphere that the jointing will not count for a great deal.

IT goes without saying that this is a very decided innovation in the color treatment of the exterior of a building. As the work is not yet entirely completed, it is different to judge of what the result will be. Indeed it might almost be said that no correct conception of the effect can be had until after the building has been occupied a sufficient length of time for the elements to have added their touch to the final mellowing of the whole. The colors are certainly not arranged by mere caprice, but on the contrary are studied with a distinct general idea in view. Every one knows the tiresome monotony of a perfectly plain wall surface which presents no variations in color, and every one knows, on the other hand, the delight which is afforded by the contemplation of a wall surface broken up in the multitude of tones and shades which characterize the Doge's Palace at Venice. Tremont Temple shows a deliberate attempt to treat the front of a building exactly as one would treat a water-color. The tones are graded and softened into each other, the lines of the diaper work are blended together, and thus far there is not the slighest suggestion of the oil-cloth effect which might easily present itself without the most careful study and supervision. However successful the scheme may finally be considered, it is certainly a daring attempt to break the monotony of the average commercial building. The building will be either greatly admired or strongly detested, and the outcome of the experiment will be watched by every artist with a great deal of interest.

THE following is from the inaugural address of Mayor Curtis: "I recommend that the Architect Department be abolished. The City of Boston, unlike some of the other great cities of the country, has no 'board of public works' upon which falls the responsibility for the construction of all its buildings. On the contrary, its affairs are managed by departments. Each department should transact all its business, and if appropriations are made for new buildings for any department that department should employ an architect to draw the necessary plans and supervise the work, and should be responsible for the result.

"I believe that competition among architects would result in the city's obtaining the services of the best men in this profession, that the style and character of our public buildings would be improved, and that on the whole the work would be performed more expeditiously and at less expense.

"I wish it distinctly understood that in making this recommendation I do not reflect on the present city architect, nor on any of his predecessors in the office. In fact, I think the present incumbent of the office agrees with the recommendation. The salary paid the city architect — $3,500 — is not, in my judgment, sufficient to command what should be the exclusive services of the best talent, while the buildings erected by the city are among the most expensive and noticeable. That we have in the past secured temporarily men of high standing in the profession is no guarantee that we shall be so fortunate in the future.

"The frequent changes in the office have often made it necessary for an incoming architect to complete the unfinished work of his predecessor in office, and where faults in construction and excessive cost have resulted it has been difficult to place the responsibility."

THE Boston *Herald*, in commenting on the Mayor's recommendation, says: —

"The recommendation that the office of city architect be abolished is one which we should like to qualify by suggesting that, instead of having the various heads of departments decide the character of the public buildings that are to be erected, all competing designs made by architects should be approved before they were accepted by a board made up, say, of the Mayor of the city for the time being, the president of the Society of Fine Arts, and the president of the Architects' Society. If some such check is not placed upon the judgment of the average head of a municipal department, we are inclined to think that we shall have in the future some public buildings that are both fearful and wonderful in the character of their artistic composition."

Mr. Wheelwright is entirely in accord with the Mayor's recommendation so far as abolishing the office is concerned, but in an open letter suggests a plan for the governing of this part of the city's work which differs from those proposed by his Honor.

YIELDING to the demand from many of our subscribers, and with the conviction that the usefulness and attractiveness of THE BRICKBUILDER will be largely enhanced, we have decided to take from our reading columns all advertisements. In doing this we are strongly of the opinion that the interests of our readers and advertisers will be better served. In connection with this change, we would call attention to the rearrangement of the Index to Advertisements, on page xix, which, we believe, will be found to be most comprehensive and useful.

OUR ILLUSTRATED ADVERTISEMENTS.

A VERY attractive feature in this month's issue is the large number of half-tone illustrations of brick and terra-cotta work, old and new, which may be found in our advertising columns.

CAMPANILE OF THE CHURCH OF ST. JOHN'S AND ST. PETER'S, ROME,

is the subject of this month's illustration, which appears in the Hydraulic-Press Brick Company's advertisement (see page xvii).

FIFTH AVENUE THEATRE, NEW YORK.

Looking from the window, which forms the central figure in the new design for the New York Architectural Terra-Cotta Company's advertisement (see page xvi) there may be seen the front elevation of the Fifth Avenue Theatre, which is particularly rich in terra-cotta design, examples of which we publish herewith.

The illustration in this advertisement will be changed each month, giving a series of the best examples of recent terra-cotta work which has been executed by this company. Supplementary to the illustration which appears in the advertisement we shall print bits of terra-cotta detail used in the building illustrated.

A FAIENCE MEDALLION, MADONNA AND CHILD,

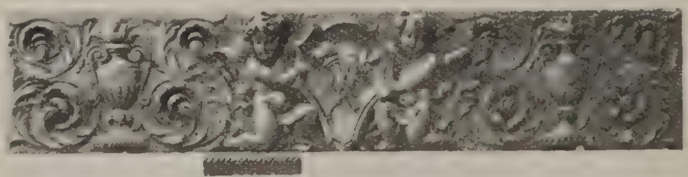
executed by Andre della Robbia, photographed from the original in the National Museum, Florence, is the illustration chosen by the Atwood Faience Company for their advertisement this month (see page xv). We intend to publish soon some illustrations of work recently executed by this company showing the excellence of their productions.

THE NEW ODD FELLOWS' TEMPLE, PHILADELPHIA,

which is a strikingly beautiful example of brickwork in the lighter shades, is the subject chosen by the Eastern Hydraulic-Press Brick Company for illustration (see page xviii).

THE BROOKLYN STORAGE WAREHOUSE.

A most excellent example of the massive design may be found in the advertisement of The Clinton Metallic Paint Company (see page xxi).



By preserving these illustrations, which are changed each month, one may become possessed of a valuable collection of illustrated brick and terra-cotta work, old and new.

FIREPROOFING.

A Department Conducted in the Interests of Building Construction to Prevent Loss by Fire.

SKELETON CONSTRUCTION.

FIREPROOFING. FOUNDATIONS.

AN article by the writer, published a few months ago in THE BRICKBUILDER, contained some mistakes.

It was stated that the cantilever foundations in the Rand-McNally Building, Burnham & Root, architects, were the first embodiment of that principle in foundations for office buildings; whereas, in fact, the writer (who himself was concerned in the planning of the Manhattan Building) is reminded that the Manhattan preceded the Rand-McNally Building somewhat. When the permit for the former was being applied for, it was found that, owing to the presence in the adjacent basement of boilers which could not be disturbed for the insertion of adequate foundations for the abutting walls of the two buildings, it was necessary to support the side walls of the new building independently of the old foundations. Then it was that the idea occurred to Mr. W. B. Mundie, of Jenney & Mundie, the architects of the Manhattan Building, that the cantilever principle could be used. This, probably, was the first use of the cantilever foundation (March, 1890), and it has been used frequently since in other notable buildings. The Rand-McNally foundations followed so closely after the Manhattan that very likely Mr. Burnham and Mr. Mundie hit upon the happy idea simultaneously and independently.

For a still earlier suggestion, if not application, of the cantilever in foundations, the reader is referred to an extract from a letter to the writer, quoted hereinafter.

It is a mistake if these articles have in any way given an impression that any Chicago man claims to have invented isolated foundations. As one remarks, "They are as old as the art of building." Mr. Frederick Baumann, in a pamphlet, "Foundations," published in 1873, said: "Such isolation of piers has been, however, the exception, not the rule. Its origin is from chance and circumstance, not from logic. I, on the other hand, advance a principle which makes isolated piers the rule in all cases, and continuous foundations the exception." In a recent letter to Mr. Jenney, Mr. Baumann observes that in two particular buildings with continuous foundations he noticed, in 1892, "a going out" of the corner piers, and he says: "In 1853, I made plans for the Marine Bank and decided at once for isolated piers, which were constructed with a happy result. Ever since then I advocated the principle of isolated piers." He says also, that these first foundations were of rubble stone, — "dimension stone at the time was not even dreamt of, till about '55."

Mr. P. B. Wight, kindly answering a question asked by the undersigned, writes as follows concerning isolated foundations: "As used in Chicago office buildings, . . . if meaning thereby foundations with iron rails and beams imbedded in concrete, I will say that I think I did invent them. On this supposition, Mr. Burnham has informed you correctly, for he is my best witness. In explaining how it was, I am obliged to correct one statement you made in your article. I never was aware that Gen. Wm. Sooy Smith was employed as consulting engineer on the Montauk Block. I was employed as consulting architect in connection with Burnham & Root, and it was not until the company that I was organizing had obtained the contract for the hollow-tile floor, arches, and concreting, as well as protecting the columns and girders, in that building, that I resigned my position. In that capacity I made plans for the foundations of the building, which were generally of the pyramidal order, and it was the first building in which the basement was largely sacrificed for that purpose. But finding that this system, allowing the proper offsets in the courses of stone, would carry the foundations for several stacks of vaults above the basement floor, I inserted railroad iron in the course of concrete under these stacks, so as to give very large offsets to the concrete. This was the first use of iron rails for that purpose that I am aware of.

"Part of the walls were on continuous foundations, and where there were large openings in the basement story with iron mullions I inserted double rolled iron beams under them. This I had done eight years before in the American Express Building, on Monroe Street.

"There are other particulars in which the Montauk Block marks a new era in the erection of high buildings. It was on my recommendation that the adjoining building, which had an independent wall, was put on screws during the whole time of the erection of the Montauk Block. These screws were in a continuous row, and rested on the offset of the foundations of the Montauk Block, which now supports both buildings.

"This building does not have brick floor arches, as you state, but all the floors are carried on six-inch flat hollow-tile arches. They are peculiar in this respect, that they are the first hollow-tile arches ever made with walls not more than half an inch thick, and the first ever made of pure fireclay. This marked the era of very light floor construction, which helped to make the erection of very high office buildings possible.

"With regard to the credit due for other valuable inventions used in Chicago buildings, I will add what may be, in some respects, a correction of what you have said on that subject. Mr. Jenney is entitled to the credit of using a complete iron framework sufficient to support all the floors above the first story, independent of the enclosing brickwork, but the Home Insurance Building is not an example of skeleton construction as now understood. In that building the brick piers are built entirely around the cast-iron columns except in the original upper story, where they are covered with tile on the inside. There is no separate and independent lining of hollow tile. The first building in which a complete skeleton wall was built, that I am aware of, was the Phœnix Insurance Building, now the Western Union Telegraph Building, in which the rear wall, or about one hundred lineal feet of it, is a complete skeleton construction, with enamelled brick on the outside, and a hollow tile wall on the inside. Each is supported on its own system of horizontal beams. This was done by Burnham & Root, one year later than the Home Insurance Building, and was the prototype of the court construction of the Rookery.

"Mr. Beman used railroad iron in the foundations that were laid for Marshall Field's building (to a limited extent only, — most of these were pyramidal, dimension stone foundations), where the Woman's Temple now stands, shortly after the Montauk Building was built. These were afterwards taken out when the Temple was built. It was during the litigation between Field and D. Z. Leiter over these foundations that Mr. Jenney gave testimony advocating that the outer wall of such a building could be built on cantilever foundations, which, I think, was the first suggestion of the kind ever made. The best illustrations of this system may be seen not only in the Rand-McNally Block but in the Ellsworth Building, on Dearborn Street, by J. M. Van Osdel.

"I was witness of all that was done at the Home Insurance and Phœnix buildings, for I was manager of the company that did the hollow-tile work on both buildings.

"Yours truly, "P. B. WIGHT.

"P. S. In the *Inland Architect* for March, 1892, you will find a description of my early experience in building foundations in Chicago, the facts of which have never been disputed, — this in Part II. of the series, 'Recent Fireproof Building in Chicago.'"

In this issue of THE BRICKBUILDER are presented selections from the working drawings of the Wyandotte office building of Columbus, Ohio, one of the latest buildings designed by D. H. Burnham & Co.

D. EVERETT WAID,
Chicago.

FIREPROOF FLOOR ARCHES.

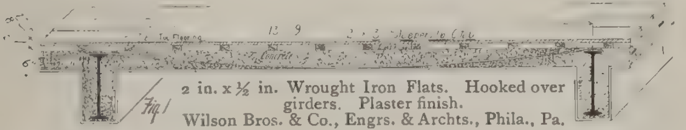
By George Hill, C. E.

PUBLISHED TESTS.

THE first thing that a wise man does, when looking into some new subject, is to ascertain what is the state of the art, and learn as far as possible what has been done by others in the line that he intends to investigate.

We shall, therefore, for a time consider this branch of the subject, briefly summarizing tests which have been made by others in the line of determining the strength or other characteristics of the fireproof floors.

Wilson Arch (*Engineering Record*, May 24, 1890, page 392): This arch is made of concrete and iron, and in the manner indicated in Fig. 1.



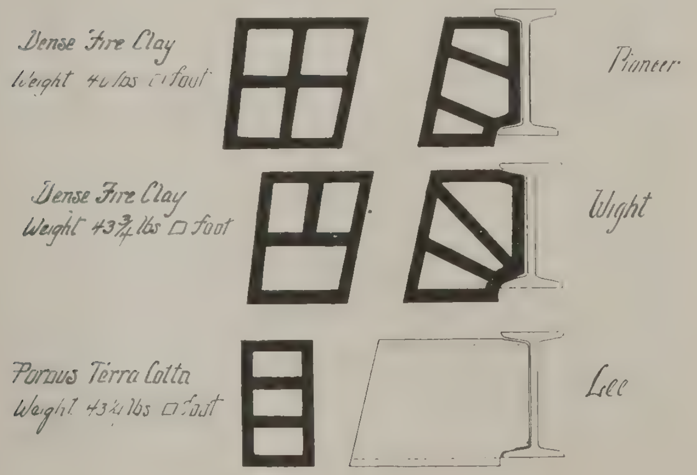
2 in. x ½ in. Wrought Iron Flats. Hooked over girders. Plaster finish.
Wilson Bros. & Co., Engrs. & Archts., Phila., Pa.

They publish this statement: "The capacity of this floor is not given, but was indicated by two photographs, one showing it sustaining a load of bricks piled over its entire area about three feet high, and another showing it collapsed by a little increase of the load." This would indicate an ultimate strength of about three hundred and seventy-five pounds per square foot, and efficient strength with a factor of safety at ten of about the actual load of the arch. It is quite probable that this was by no means a fair test. It is also probable that the arch had not been constructed a very great while, and that consequently the concrete had not had an opportunity to thoroughly set. Generally it will be seen that the depth of the sag to the strap iron is not such as to fully develop its strength in an economical manner. The general principle of this arch is that of having metal supply the tensile strength, while the concrete supplies the compressive strength. When it is desired to put in a flush ceiling a similar construction of much less depth is applied to the lower flange of the beams; this being so much less in depth is, of course, likely to somewhat sag.

DENVER TEST.

These tests made at Denver, Col., in December, 1890, by Messrs. Andrews, Jacques and Rantoul, and published in *The American Architect* for March 24, 1891, are so widely known, and were so carefully prosecuted, that they have come to be always thought of whenever we think of the matter of tests of fireproof floor arches. The information in detail concerning these tests has also been so wisely scattered that it is unnecessary at this day to go into it. It will be recalled that the arches were of three makes, the Pioneers, the Wight, and the Lee, and of section similar to the sketches of Fig. 2.

Fig. 2



A glance will show that the area under compression in these various arches is varying in amount, and if we desire to know which is the best we should know what the sectional area of the working section is in each case. This has been entirely omitted from the records of the test as published, and cannot therefore be ascertained. All that we know concerning the arches is to be obtained from the photographs and sketches in the report. The arches were tested, *first*, by still load; *second*, by shock; *third*, by fire and water; *fourth*, by continuous fire. These tests were each applied to all of the arches, and the results are thus summarized in the report as published in the *American Architect*.

"TEST A.

"*Still-load Test.* — The test for still load was made on the arches marked, A-1, A-2, and A-3. It was decided to apply the weight to the arch by piling up pig-iron on a space three feet square in the middle of the arch. A curbing, or box without either top or bottom, three feet square and four inches deep, was placed on the middle of each arch, and this box was filled up with dry sand, and on the sand pig-iron was laid, and steadily and continuously applied without shocks until the arch broke. The weight of the box was 82 pounds, and the weight of the sand inside the box was 350 pounds, making a weight of 432 pounds on each arch, besides the weight of the pig-iron.

"*Arch A-1.* [Built by the Pioneer Fireproof Construction Company.] The pig-iron was placed on this arch when it was not quite four days old. The pig-iron was weighed before placing on the arch, and it was carefully put on, so as to avoid shocking the arch. When a weight of 1,917 pounds of pig-iron had been placed on the arch the deflection was measured, and found to be .01 of a foot. When a weight of 4,000 pounds had been placed on the arch the deflection was found to be .012 of a foot. When a weight of 5,429 pounds of pig-iron had been placed on the arch the arch broke suddenly and without warning, the final deflection not being measured. The arch broke from beam to beam, the whole arch coming out except the side of the abutment pieces on the right-hand beam, which were still held to the beam by the mortar. *The right-hand side seems to have given way first, apparently because of the failure of the right-hand abutment pieces.*[1] The left-hand abutment pieces dropped on the ground, whole and unbroken. The mortar seemed to be very good and quite hard for four-days-old mortar. The failure of the arch does not seem to have been caused in the slightest degree by the mortar, *as the failure was, beyond a doubt, in the angles of the right-hand abutment pieces.*

"*Arch A-2* [built by Thomas A. Lee] was next tested for still load. This arch was prepared just the same as the arch A-1, with the curb and sand, before the pig-iron was applied to it. This arch was, practically, of the same age as the arch A-1. When a weight of 2,050 pounds of pig-iron had been applied to the arch the deflection was measured, and found to be .015 of a foot. A weight of 4,337 pounds produced a deflection of .016 of a foot; 5,965 pounds produced a deflection of .024 of a foot; 7,981 pounds was sustained for twenty-five minutes while a scaffolding was being erected around the arch; 8,997 pounds produced a deflection of .038 of a foot; 10,284 pounds produced a deflection of .04 of a foot; 11,532 pounds was carried for thirty minutes while scaffolding was being raised; 12,245 pounds caused a side deflection in the beams of about three eighths of an inch in the length of the arch; 13,325 pounds caused a deflection of .055 of a foot. When 14,494 pounds had been applied a photograph was taken; 15,145 pounds produced a deflection of arch of .065 of a foot, the deflection of beams having increased to about one half an inch. The loading of this arch stopped at this point, as it was feared that the pile of pig-iron would topple over and injure the workmen. This load of 15,145 pounds was left on the arch for two hours, when the load was removed, and the same block of wood which was used in the shock test was dropped on this arch, A-2, from a height of ten feet above the arch. The arch broke at the third drop. The load 15,145 pounds opened the joint at the bottom of the key about one quarter of an inch in the entire length of the arch, and opened the joint at the upper edge of the skew-backs at the sides near the top. When the load was removed the beams resumed their straightness, and the arch recovered from its deflection and was apparently uninjured in any respect.

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[1] Italics ours.

"*Arch A*-3. [Built by the Wight Fireproofing Company.] The box and the sand were prepared on this arch just the same as for arches A-1 and A-2. The age of the arch was, practically, the same as the others. 2,358 pounds of pig-iron produced no deflection; 3,073 pounds produced a deflection of .008 of a foot; 6,012 pounds produced a deflection of .017; 8,024 pounds produced a deflection of .018. When 8,574 pounds of pig-iron had been placed upon this arch the arch gave way suddenly without warning, clearing out the whole arch from beam to beam, falling vertically without disturbing the pig-iron and *apparently failing in the abutment pieces, both abutments being sheared right off, the failure seeming to be in the angles of the abutment pieces.*

"TEST B.

"This was a test to show the comparative resistance of the different arches to shocks or blows. The arches tested were marked B-4, B-5, and B-6. The blows were given the arches by dropping upon them a piece of Oregon pine 12" square and 4' long. The weight of this stick was 134 pounds. At the request of the Pioneer Company, the specifications were altered for this test, so that instead of starting with a drop from a distance of twelve feet, as specified, the first blow was delivered from a height of six feet, the height to be gradually increased. This change was agreed to by the other competitors. The tops of the arches were protected by covering them with one and one half inches of loose, dry sand.

"*Arch B*-4. [Built by the Pioneer Fireproofing Company for the dropping test.] The 12" x 12' stick 4 long, weighing 134 pounds, was dropped on this arch from a height of six feet, the stick being in the middle of the arch and at right angles to the beams. At the first blow the whole arch was shattered to pieces and utterly destroyed, not a particle of it remaining on the beams.

"*Arch B*-5. [Built by T. A. Lee for the dropping test.] The same stick was used here, and the first drop from a height of six feet was at right angles to the beams. The second drop, parallel to the beams, from a height of six feet, broke off the bottom web of one tile. Third drop, right angles to the beams, from a height of six feet. Fourth drop, parallel to the beams, from a height of six feet, broke off the bottoms of two tiles. Fifth drop, from a height of eight feet, at right angles to the beams, broke off part of rear rib. Sixth drop, from a height of eight feet, parallel to the beams, broke the key on the rear course, the entire tile falling out. Seventh drop, from a height of eight feet, at right angles to the beams, the whole rear course dropped out. Eighth drop, from a height of eight feet, parallel to the beams, front key tile broke. Ninth drop, from a height of eight feet, at right angles to the beams, punched a hole clear through in the middle of the arch, three tiles out, — one a key tile. The top of the arch was photographed after this blow. Tenth drop, from a height of eight feet, parallel to the beams, four whole ribs gone entirely. Eleventh drop, from a height of eight feet, parallel to the beams, the arch dropped.

"*Arch B*-6. [Built by the Wight Fireproofing Company for the dropping test.] The same stick was used here, and the first drop from a height of six feet, at right angles to the beams. caused the arch to fall. *The skew-backs in this arch gave out, being broken to pieces.* The intermediate and key tiles seemed to stand first rate; only one intermediate tile broke in the whole arch; it was a tile next to the abutment. All the rest of the intermediate and key tiles held their shape and simply dropped to the ground unbroken.

"*C*-7. [Built by the Pioneer Company for the fire-and-water test.] After the fires first built were drawn, pieces of the lower web fell from several tiles,— not all at once, but at intervals. This was probably due to the shock of the impact tests, which were carried on beside this arch, though the shock felt by the arch must have been very slight after transmission through a number of feet of earth. Started fires of kindlings at 3.25 P. M., Friday, and started use of Rouse coal. At 3.50 there was a very hot coal fire under the arch. At 5 the temperature of the arch was 1300°, and the first stream of water was applied for two minutes. The bottom web fell from two tiles. The fire was at once started again, and at 5.47 the temperature had risen to 1650°, and a second stream applied, this time for four minutes, with the result of several more pieces of the bottom web falling and the practical destruction of one whole tile.

"A considerable time was required to again raise the temperature of the arch to a desirable point. This, we think, was due to leakage of air through the partly destroyed arch. However, at 7.21 the temperature was 1350°, and the third and last water test was applied, and destroyed the arch so completely that no further test was deemed necessary. The bricks over the centre of the arch fell about two inches, but the mass of the load formed an arch resting on the skew-backs, and became self-supporting. One entire row of tile was destroyed, and the majority of the remainder were broken and partially fallen, so the arch was considered a ruin and abandoned. After the front of the brick setting was removed it was found that the arch, in falling, had lodged on the setting, and was thus prevented from falling completely. The final condition of the arch, as seen after part of the setting was removed, was as follows: —

"The skew-backs were intact on both sides; the rib of the intermediate next to skew-backs remained in each tile on the skew-back, showing that the mortar had not given way. Both intermediates to left of the key in the two centre courses were wholly destroyed, as was the intermediate next to the skew-back in the front course. The greater part of the intermediates next to the skew-backs for three courses on the right of the key had fallen, and the front key tile was partially destroyed.

"*C*-8. [Built by Thomas A. Lee for the fire-and-water test.] Fire of kindlings and coal was started at 3.25, and an excellent fire was burning at 3.50. About 4, the lower web of a tile next to the key in the course next the rear fell out without apparent cause. The arch was at a temperature of 1450° at 4.57, when the first stream of water was applied for two minutes. No change in the arch was apparent. The fire was started again at once, and at 5.42, the temperature being 1230°, water was again applied, this time for four minutes. No tile fell. This alternation of fire and water was continued, and the water was applied for four minutes at each of the following times: 7.20, 8.17, 9.49 P. M., 1.49, 6.50, 8.15, 10.03, 11.53 A. M., 2.30 P. M. — eleven times in all. The temperature was generally above 1200°. At 9.49 P. M., Friday, a piece of the web of the key of the fourth course of tile came down, but, with the exception of this piece and the one previously mentioned, the arch remained intact to the end. A longer time was required to raise the arch to a high temperature after each wetting. On this account we were unable to apply the water test as often as to C-9. We presume this was due to the large amount of water that this tile could absorb, which had to be evaporated before the tile could become hot. This is proved by experiments made by us, which give the following moisture-absorbing powers for the material for the various arches in percentages of weight of water take-up.

C-7, Pioneer	5.7 per cent.
C-8, Lee	32.5 "
C-9, Wight	5.5 "

"At the end of the test, about twenty-three hours after the start, the arch was practically whole. The only tiles broken were the key and intermediate next to the key on the left of the course next to the rear. The front had been removed to allow light to enter, but the sides were still intact.

"*C*-9. [Built by the Wight Company for the fire-and-water test.] Fire was started under this arch at 3.25 P. M., and the tile was at a temperature of 1450° at 4.53. A stream of water was then applied for two minutes, without result, which was also the case when the water was applied for the second time at 5.38, the temperature being the same as before. The third trial at 7.00 brought down the bottom webs of the intermediate tiles on both sides of the keys. The water was applied for four minutes in this and succeeding trials. At 7.49 the temperature, when the water was applied, was 1320°, and the bottom webs of two more tiles on left of key and the bottom web of an intermediate tile on each side next to the skew-backs fell. After the water was applied at 8.50 every tile was broken in its bottom web, and a sagging of the load of brick was noticed. The upper web of the tile seemed to be solid. At 9.43, 10.34 P. M., 1.49, 6.15, 7.00, 8.15, 9.57, 11.05 A. M., 12.32 and 2.30 P. M. (fourteen times in all), we continued to apply the stream, with the same result of knocking down a few pieces of the tile each time. No particular change was seen in the load.

"When the test was stopped the lower web was completely gone from every tile and much of the vertical and intermediate ribs. The upper web seemed to be completely whole.

"The total combustible burned under these arches was as follows: —

C-7	552 lbs.
C-8	1,466 "
C-9	1,538 "

"*Continuous-fire test.*

"Under D-10, D-11, and D-12 the fires were started at 3.25 P. M., and were first fed with Rouse coal to the extent of 300 lbs. each, after which anthracite was used to the end of the test. The fires were forced as much as possible, and the arches were white hot for nearly the whole time. The amount of coal burned in D-11 was less than in the others, but it does not necessarily follow that the heat was any less. In fact, the arch presented a much hotter appearance than D-10 or D-12, and the fire was forced as much as possible. The position of the dampers was not easily regulated, and while the more open the damper the greater the amount of coal burned, there was also a much greater loss of heat through the chimney. We consider that D-11 was tested as severely as the other two. Such temperature measurements as we were able to take showed as high temperatures as were reached in D-10 or D-12.

"All the arches lasted through the test, which ended at 3.25, Saturday, making the total length of the test twenty-four hours. No tile fell from either of them, and until the furnace settings were removed they were apparently in as good order as when first fired, though the bottom webs of each showed numerous cracks and slightly open joints.

"The total combustible burned under the arches submitted to the continuous-fire test was: —

D-10	1,916 lbs.	80 lbs. per hour.
D-11	1,529 "	64 " " "
D-12	1,942 "	81 " " "

"The loads of brick were left on the arches until Monday morning, Dec. 22, when we proceeded to remove the walls of the furnace settings under the I-beams, care being taken not to jar the arches while the brick was being removed.

"*C-7.* This was a wreck, but it was found that the intermediate tile in the front course to the left of the key in falling had lodged on the furnace setting and supported the rest of the arch and the few bricks from the load that had fallen with the arch, and when the bricks of the setting were removed the whole arch fell.

"*C-8.* The whole setting was removed without any deflection of the arch, which remained entirely supported by the I-beams, as originally constructed. The bricks of the load were removed from the sides and piled in the centre to concentrate the load, but without effect on the arch.

"*C-9.* This whole arch was seen to be be cracked in all directions before the setting was removed, and when this was done it fell at once.

"*D-10.* After taking out the front and side walls, the arch was seen to be cracked from top to bottom in the ribs, the bottom webs had fallen from two tiles, and the right skew-back front gave way, the arch settled but held until the back was removed, when it fell entirely.

"*D-11.* The entire setting was removed without any change in the arch, and the removal of the outside bricks of its load to the centre had no effect. The right front skew-back was cracked in the lower web near the I-beam.

"*D-12.* One bottom web fell out while the setting of D-11 was being removed, and the whole arch fell when its setting was taken down.

"Arches C-7, C-9, D-10, D-12 would doubtless have fallen during the test had the furnace settings been differently arranged. The interior of the setting was smaller than the arch itself, so the outer edges of the arches rested on the settings, and so received support.

"At 3.45 P. M., Monday, arch C-8 was still intact with its load. The bricks were then removed from it, and, having covered it with a layer of sand, we subjected it to a series of blows from the timber used in the previous impact tests. The first blow was at right angles to the I-beams and the drop was six feet. Several loose pieces from the lower webs of centre tiles fell, which we consider to be the extent of the tile affected by the heat. The second, third, and fourth blows were alternately parallel and at right angles to the I-beams and the drop was six feet. A few loose pieces of small size fell each time. The height of drop was increased to eight feet and the blows were alternated in direction, as before. In the fifth, sixth, and seventh blows the lower middle webs began to be fractured and a hole was broken through at the back in the centre of the arch. The ninth blow, across the arch, knocked out a hole two by three feet from the centre of the arch, but two more blows along the arch were required to completely demolish it, but the arch was still solid.

"The load on D-11 was left on it until 5 P. M., Monday, when the bricks were taken from each side and piled on the centre, so as to concentrate the load on the three centre tiles, and was left in this condition until 9 A. M., Tuesday. It was then noticed that the joints along the middle of the bottom were slightly open, and the I-beams were slightly sprung apart. Bricks were then piled upon the load until there was a weight of 12,500 pounds resting on an area of the centre of the arch, measuring thirty-six inches across the arch by fifty inches along it.

"It was deemed unsafe to the men to build the load higher, since it was very unstable and likely to topple over. The arch, however, was apparently sound, and its deflection did not exceed five eighths of an inch.

"The following data, obtained from experiments made by us upon samples of the different tiling entering into the construction of these arches, have their value: —

Specific Gravity.

C-7 equals 2.40
C-8 " 1.99
C-9 " 2.44

Specific Heat,

or amount of heat required to raise equal weights through same range of temperature: —

C-7 equals 0.19
C-8 " 0.18
C-9 " 0.20

or, what is more desirable in this case, the

Specific Heat per Unit Volume.

C-7 equals 0.456
C-8 " 0.358
C-9 " 0.488"

(*To be continued.*)

IF you have not seen the little booklet entitled "Our Maiden Speech," issued by the Akron Vitrified Pressed Brick Company, Akron, Ohio, you had better send for one. It is original and to the point.

MORTARS AND CONCRETES.

A Department devoted to Advanced Methods of using CEMENTS and LIMES in Building Construction.

CONCRETES, CEMENTS, AND MORTARS: OLD AND NEW.

(*Continued.*)

HYDRAULIC limes are seldom used in this country, owing to the abundance of hydraulic cements, which are more economical in many ways. Hydraulic limes contain from twenty-five to thirty-five per cent of impurities. They slake slowly, with a slight rise of temperature and an increase in bulk of nearly one third; they will set under water in from one to twenty days. The mortars made with hydraulic lime require to be mixed the same way as common lime-mortar, and in about the same proportions. Use clean water and sharp pit sand.

Hydraulic cements are made from limestones containing from forty to sixty per cent of impurities. These stones are calcined, and then ground fine, when they are ready for use. They do not slake at all, so that their bulk and temperature remain the same while mixing and setting, and they may therefore be used *neat* in a pure state. These cements set quickly either under water or exposed to the air. Deposits of natural cement stone are found and worked in the United States and Canada, principally in New York, Pennsylvania, Virginia, and on the banks of the Welland Canal, Canada. The principal deposit is found near the town of Rosendale, Ulster Co., N. Y., near the Hudson River, and the name of the town gave the name to the cement, which is now known from Maine to Alaska, and Hudson's Bay to Key West. It was first brought into use about 1823, during the building of the Delaware and Hudson Canal. Now, the average output amounts to about two million pounds annually.

A similar cement is made in Utica, another in Akron, N. Y., and still another in Milwaukee, Wis., and in Louisville, Kansas City, Kensington, Trinidad, and Thorald, Ont.

The best Rosendale cement varies in weight from fifty to fifty-six pounds per cubic foot, the hardest burned and finest ground being the heaviest. Ulster County cement averages three hundred pounds net per barrel; while Utica, Akron, Louisville, and Milwaukee weigh only two hundred and sixty-five pounds per barrel net.

The Rosendale quarries or ledges are of some twenty or more different strata, and vary from a cement that sets in three minutes to one that takes an hour and a half to set. The best cement made at these quarries is a mixture of several strata in the proper proportions. The following analysis shows the variations occurring in the different strata of the Rosendale quarries, which is quoted from an official authority: —

	PER CENT.	PER CENT.
Silica, clay, and insoluble silicates . . .	11.10	39.47
Alumina (Al_2O_3)	2.34	7.50
Sesquioxide of iron (Fez. O_3)	0.76	5.33
Carbonate of lime (Ca CO_3)	28.48	46.00
Carbonate of Magnesia (Mg. CO_3) . . .	14.48	39.04
Potassium and sodium chlorides	1.68	7.42

According to one authority, Rosendale cements may be tested as follows: "Take two handfuls of cement and mix with as little water as will make the mass into a stiff paste. Make into two little cakes; place one of these in water, expose the other to the air. If the cake exposed to the air dries of a light color without any definite cracks, and the one immersed sets with a darker color and free from cracks or fracture, the cement may be considered good." Another test to ascertain the soundness of the cement, which is the property of not swelling or shrinking, or cracking in setting, is to place some of the mortar in a glass tube or vial, or in an ordinary swelled lamp chimney, and fill with water. If the glass breaks, the cement expands, and should be rejected if intended for wet places.

Gilmore states the adhesion of Rosendale cement to the front bricks, after twenty-eight days, when pure, to be thirty pounds, and mixed with one and two parts of sand, sixteen and twelve pounds.

Desmith found the Virginia cements in pure state, after thirty days' exposure, one hundred and seventy to two hundred and fifty pounds tensile strength per square inch, which increased in eleven months to three hundred and sixteen and three hundred and eighty-one pounds. Mixed with equal portions of sand, he obtained from one hundred and sixteen to one hundred and thirty-five pounds, and one hundred and eighty to one hundred and ninety after eleven months' exposure.

Clarke reports the tensile strength of Rosendale cements, pure, after one and twelve months, as one hundred and forty-five and two hundred and ninety pounds.

Mixed, one and one, after one and twelve months, 116 and 259 pounds.

Mixed, one to two, after one and twelve months, 60 and 180 pounds.

Mixed, one to three, after one and twelve months, 35 and 121 pounds.

The proportion of tensile to compressive strength averages probably, after one month, one to four; and rises after two years to probably one to six. The specifications of the engineer's department of the District of Columbia require seven days after mixture, for *neat*, natural cement, ninety-five pounds, and for mixture of one and two parts of sand, fifty-six and twenty-two pounds tensile strength per square inch.

As a general rule, cements set and harden better under water than when exposed to air, although, if the temperature for the first few days does not exceed 60° F., there seems to be no appreciable difference; with a higher temperature, the cement dries instead of setting, and thus loses much of its strength. It attains its maximum hardness only after a lapse of many years, although after the first year the increase is very slight.

Sand retards the setting of all cements, and weakens Portland in about the following proportions: —

1 pint sand to 1 pint cement gives $\frac{1}{2}$ strength of pure cement.
2 " " " 1 " " " $\frac{1}{3}$ " " " "
3 " " " 1 " " " $\frac{1}{4}$ " " " "
4 " " " 1 " " " $\frac{1}{5}$ " " " "
5 " " " 1 " " " $\frac{1}{6}$ " " " "

Rosendale being reduced somewhat less.

The following remarks and directions, which have been gleaned from standard authorities on the mixing and using of cements, may not be out of place at this juncture: All cements of good quality manufactured in the United States or Canada, when mixed in proportion of two of sand to one of cement, will give a mortar sufficiently strong for most engineering purposes. A good Portland, like the Dyckerhoff, the Boulogne, or the English Imperial, will give an equally strong mortar with from three to four parts of sand; and, although costing much more than our native cements, may still be, in some cases, the more economical.

All sand used with mortars or cements of any sort whatever should be clean, sharp, and coarse. Fine sand, and especially water-worn sand, delays the setting, and deteriorates the strength of cements. Damp sand should be well mixed before the dry cement is put with it. Mix both well together while dry. Use no water until just before the cement paste is required.

The larger the proportion of cement, the stronger will be the result. For cisterns and works under water, the best proportions are one and one. For floors and walks, the cement should be increased near the surface. Use no more water in mixing than is absolutely necessary.

Whenever concrete is used under water, see that there is no ripple or current, as the water should be perfectly still. In still water, cement will harden quicker than in air, and when kept in water will be stronger than when kept exposed to the air.

Cements that set quickly in air harden slowly under water, and should not be used in such positions.

In putting down cellar floors of concrete, the material should be dampened, and then tamped down with a block of wood similar to a paving hammer, then finish off with a trowel. When required, finish off with neat cement, and if well done the floor will be as hard and as compact as natural stone.

All good cements require to be used immediately after mixing, or they will set on the mortar board, and become useless. Poor cements may stand longer, as they do not set so quickly.

Buildings, either brick or stone, are, in a measure, cyclone proof if the mortar used is composed of good cement. Chimneys laid in mortar of this sort never blow down, and while the extra cost is not great, the value of the buildings is much enhanced.

Cement may also be mixed with common lime mortar for plastering with advantage. Good cements may be stored away for years in barrels or other tight vehicles, and, if kept free from moisture, are not injured the slightest bit.

Cold seems merely to retard the action of setting, and if the mortar thaws equally no serious harm results, so that, if necessary, work may be continued when the temperature is below zero, care being taken that the mortar thaws equally on both sides of the wall. Do not heat the sand, cement, or water above blood warmth.

In every important work each lot of cement should be tested before being accepted, and the superintendent should have the power to reject any cement he might think not up to the standard.

A careful adherence to the foregoing hints will, almost in every case, produce satisfactory results.

FRED T. HODGSON, C. E.

FINENESS OF PORTLAND CEMENT.

THE writer does not think that Mr. Hodgson, in his valuable article on "Cements, Old and New," has made clear to the reader the relative value of weight to fineness in Portland cements. The old advocates of weight were right, in a measure. To get the best results from a Portland cement composition, the clinker must not only be ground fine but must be burned hard, which makes the cement heavy. If the cement is not the product of heavy clinker the fineness availeth nothing. Of two Portland cements of equal fineness the heaviest one will invariably make the strongest mortar.

The principal reason the English manufacturers lost their grip on this market was due to the question of fineness. Until quite recently, they stubbornly refused to meet the importer's demand, and furnish a hard-burned cement, ground fine enough to meet the requirements of the engineering profession in this country.

To the German manufacturers is due the credit of educating this country up to requiring a finely ground cement, but it must be said to the credit of the American Portland cement manufacturers that they have been prompt in meeting this issue, and to-day the American Portland cements are, on an average, the finest ground cements on this market, and for the past three years the American and German Portland cements have supplied practically all the work which required hard-burned, finely ground cement, whereas ten years ago, when the requirements were more lax than at present, the English Portland cements supplied the bulk of it.

No better illustration of the fineness of Portland cements can be found than the report of the Engineering Commission, District of Columbia, for the year ending June 30, 1894, which shows that the

Average of six German Portlands tested was 92.8 per cent fine on a No. 100 sieve.
" " five American " " " 93.1 " " " " " " " "
" " two English " " " 83.0 " " " " " " " "

It must be borne in mind, however, that this matter of fine grinding very materially increases the cost of manufacture, and this means an increased selling price.

That more sand can be used with the finely ground cement is true, which is the reason some specifications call for 90 to 95 per cent fine on a No. 100 sieve, instead of 90 to 95 per cent on a No. 50 sieve, as was the custom a few years ago. But the addition of sand has a limit. The writer questions whether any competent engineer will allow the use of a larger proportion of sand than three or four to one, while the proportion of crushed stone, etc., will be influenced by the size and quality.

A cement may be strong enough to stand a larger percentage of sand, yet theoretically, in any cement work, all the voids are expected to be filled; and in a sand mixture larger than four to one, the writer is sure that there will not be sufficient cement to do this, no matter how fine the cement is ground. This fact limits the quantity of sand and, without being able to increase this quantity, there is no necessity of carrying this matter of fine grinding to extremes.

WM. G. HARTRANFT.

PHILADELPHIA, Jan. 1, 1895.

AS an instance of the absurd specifications made by architects of excellent standing, in regard to the use of concrete, the writer had occasion to visit a large building, recently constructed, in which the floors are of the I-beam and concrete-arch type. The span of the arch is not over six feet, but it seemed necessary to use a concrete arch some thirteen inches thick at the crown. The concrete itself was of so poor quality that it could be readily scraped up with an umbrella. It was abominably poor stuff, and although large quantities of materials were used, the result was far short of a good piece of work. It was downright poor. The arches were in many places cracked from end to end, and the load on the beams was far in excess of requirements. With one quarter of the quantities of proper material, and at very much less cost, these floors could have been made strong, and capable of great loads, whereas now they are barely capable of acting as a filling between beams.

This simply shows the absurd and downright stupid manner in which concrete is handled, even by those who stand high in the professional ranks; and until there is a more intelligent conception of its qualities, there is going to be a lasting predjudice that is nothing less than injustice to a splendid building material.

ROSS F. TUCKER.

COMPOSITION OF MORTAR.

THE Austrian Society of Engineers recently conducted experiments with a view to determining the composition of mortar best adapted to work, and to remain in permanent and effective condition when mixed and laid during freezing weather. The experiments were made first with brick masonry, two kinds of stone being used for the purpose; everything was dry and free from snow and ice, and the mortar was mixed as stiff as possible; the limes and cements were all tested in the municipal experimental station, according to the established and reliable system of the society. The conclusions of the investigating committee, as briefly summarized, are, that in brick masonry laid in frosty weather mortars into which any part of lime enters should not be used; Roman cement mortars behave fairly well under such conditions, and Portland cement mortars give good results. The use of warm water showed somewhat more satisfactory work, and salt materially increased resistance to frost. With rubble masonry, using either sandstone or limestone, lime mortar was entirely out of place, and Roman cement mortar gave unsatisfactory work unless mixed with salt; the Portland cement mortar behaved well, especially with the addition of salt. Under all the circumstances presented by these various tests, and the character of the results obtained, the final recommendation of the committee is, in laying brick or rubble masonry in winter, to use only Portland cement mortar, mixed with salt if possible. — *From British Clayworker*.

AMERICAN CEMENTS.

III.

IN order to arrive at even a fair understanding of the true nature of American rock cements, and to be able to judge accurately, or even approximately, as to the position these cements occupy in the world, and the relations they bear to the natural and artificial cements of Europe, together with the time of their first fabrication, and the uses that were made of them, and to fairly comprehend the state of the art from its earliest inception until the present time, it will be necessary to take a glance at the history of this important building material, even though it be a cursory one.

It seems to be conceded by all European authorities that John Smeaton, C. E., of England, was the first to discover the source of hydraulicity in certain limestones. The discovery was made in the year 1756, while casting about for a reliable mortar to be used in the construction of the Eddystone Lighthouse. It appears that prior to that date nothing was known as to the hydraulic character of the impure limestones of the blue lias formation which extends through several counties in England.

In the year named, Smeaton discovered, during the course of many experiments, that the cause of the hydraulicity of a limestone was due to the presence of clay in the stone.

Pasley, in the preface to his work, dated Sept. 17, 1838, says of Smeaton that "he was the first who discovered, in or soon after the year 1756, that the real cause of the water-acting properties of limes and cements consisted in a combination of clay with the carbonate of lime, in consequence of having ascertained by a very simple sort of chemical analysis, that there was a proportion of the former ingredient in all the natural limestones which, on being calcined, developed that highly important quality, without which, walls exposed to water go to pieces, and those exposed to air and weather only are comparatively of inferior strength.

"By this memorable discovery, Smeaton overset the prejudices of more than two thousand years, adopted by all writers, from Vitruvius in ancient Rome to Belidor in France, and Semple in this country (England), who agreed in maintaining that the superiority of lime consisted in the hardness and whiteness of the stone, the former of which may or may not be accompanied by water-setting or powerful cementing properties, and the latter of which is absolutely incompatible with them.

"The new principle laid down by Smeaton, the truth of which has recently been admitted by the most enlightened chemists and engineers of Europe, was the basis of the attempts, by Dr. John at Berlin and M. Vicat (the engineer) in France, to form an artificial water lime or hydraulic lime in 1818 and of mine to form an artificial water cement at Chatham in 1826, to which I was led by the perusal of Smeaton's observations, without knowing anything of the previous labors of these gentlemen on the Continent, or of Mr. Frost, the acknowledged imitator of M. Vicat in this country."

In a work on "Hydraulic Mortars," published at Leipzig in 1869, by Dr. Michaelis, the following passage occurs: "A century has elapsed since the celebrated Smeaton completed the building of the Eddystone Lighthouse. Not only to sailors, but to the whole human race is the lighthouse a token of useful work, a light in a dark night.

"In a scientific point of view, it has illuminated the darkness of almost two thousand years. The errors which descended to us from the Romans, and which were made by such an excellent author as Belidor, were dispersed. The Eddystone Lighthouse is the foundation upon which our knowledge of hydraulic mortars has been erected, and it is the chief pillar of our architecture.

"Smeaton freed us from the fetters of tradition by showing us that the purest and hardest limestone is not the best, at least for hydraulic purposes, and that the cause of hydraulicity must be sought for in the argillaceous admixture.

"It was a long time before men of science confirmed this statement of the English engineer, or corrected the ideas on the hardening of hydraulic mortars, which were then necessarily confused on account of the imperfect state of chemistry at that time. How could science subsequently keep pace with practical progress? For even at present, though we have possessed for about half a century the most excellent hydraulic mortars, the hardening process is not yet completely explained."

These extracts from eminent authorities on hydraulic cement may be taken as substantial evidence that Smeaton was the first, not to discover, as claimed by these and other writers, but to rediscover the lost art of cement fabrication. There is no doubt whatever but that the ancients thoroughly understood the value of impure limestones for hydraulic cementing purposes.

The fact is, that the history of natural rock cement reaches so far back into the early ages that it is impossible to learn precisely the date of its first fabrication. But we do know that the ancient Egyptians made natural cement four thousand years ago which would set and harden under water. The Romans over two thousand years ago made most excellent natural cement, and used it in enormous quantities for sewers, water pipes, bathing fountains, piers, breakwaters, aqueducts, etc. Prior to this time, an aqueduct over seventy miles in length was built at the ancient city of Carthage. At one place it was carried across a valley on arches over one hundred feet high, and there were one thousand arches in line. In its construction an immense quantity of natural hydraulic cement was used. Some of these arches are still standing. At one point where the arches were highest a single piece over one hundred feet in length has fallen from the top down upon the rocks below. It still lies there intact, unbroken, an excellent illustration of the toughness and tenacity of natural rock cement.

In many places in Mexico and Peru natural rock cement was used so long ago in stone masonry that the stones themselves are worn away, leaving the cement mortar projecting from the joints. During the winter of 1892, while some excavations were being made in the city of London, England, for railway purposes, the workmen came upon a heavy mass of natural cement concrete laid over eight hundred years ago.

Owing to the proximity of buildings, it could not be blasted out, and men were set to work to cut it out with chisels and hammers, and the concrete was so hard as to turn the best steel that could be obtained.

Writers on the subject of Hydraulic Cements, used by the ancients, and especially that used by the Romans, have without exception asserted that their hydraulic cement was made by a mechanical mixture of fat lime and pozzuolana.

It is inconceivable that such an absurd fallacy could obtain, and prevail throughout all the centuries from the time of Vitruvius, a Roman architect, who, it is asserted, served as a military engineer under Cæsar and Augustus, down to the time of Smeaton, in 1756, and still more absurd that it should be handed down from Smeaton's time to the present day without contradiction, when the experiments made by Smeaton, and published by him, utterly contradict such a theory.

G. R. Burnell, C. E., of London, in his work on "Limes, Cements, and Mortars, 1868," referring to Smeaton, says: "The results he arrived at were very remarkable, not only for their practical utility but also as an illustration of the ease with which a very acute observer may stop short on this side of the attainment of a great truth. Smeaton found that the commonly received opinion that the hardest stones gave the best limes was only true as far as regarded each quality considered by itself. That is to say, that of limes not fit to be used as water cements, those made of the hardest stones were the best for certain uses in the air, but that, whether obtained from the hardest marbles or the softest chalk, such limes were equally useless when employed under water. He found that all the limes which could set under water were obtained from the calcination of such limestones as contained a large portion of clay in their composition.

"His experiments led him to use for the important work of the lighthouse a cement compounded of blue lias hydraulic lime from

Aberthaw, and of pozzuolana brought from Civita Vecchia, near Rome.

"Even at the present day, it would be diffiuclt to employ a better material than this, excepting that the price would insure a preference to the Roman cement, then unknown."

Uriah Cummings.

(*To be continued.*)

CONCRETE IN COLD CLIMATES.

ON THE WEATHERING OF CONCRETE SURFACES AND CEMENT STUCCOS.

A GREAT deal of inquiry has been made of late, in view of the increased use of concrete in building construction, as to its ability to resist the action of severe climatic changes in cold localities.

In order to present some testimony on the subject, some facts have been gathered together and are here presented for the benefit of any who may be sceptical as to the weathering of concrete surfaces.

It is to be understood that in speaking of concrete we mean a good concrete, made of good material and properly handled.

It is not to be supposed that the cheap mixtures of soft materials that unfortunately pass often for concrete is to be here considered, for no one could expect that to stand anything.

Neither are we to consider the great works in concrete that were erected in Southern Europe a thousand years ago and which are to-day as strong as ever, nor yet the great buildings and structures of all kinds that have been carried out in California, in Florida, and the warmer portions of America. Every one knows of the wonderful enduring quality of concrete in those localities.

But the evidence to be brought forward will concern works in cold and frosty climates, where the disintegrating action of weather is most destructive.

In Northern Europe, particularly in Norway, Germany, Austria, England, and France, concrete has been in universal use for scores of years. It is recognized as a material to replace brick and stone not only in massive foundations and submarine works that could not be constructed in any other material, but in delicate mouldings and fine artificial stone, and in masonry walls that have to withstand the actions of the sea, as in the Eddystone Lighthouse and the wearing and chafing of ships in the great docks of Hamburg, Havre, Liverpool, and the new Manchester Canal. Again in inland work, in bridges of all kinds which have to sustain the uncertain strains of heavy traffic, concrete has done remarkable work in the most exposed localities,— in Switzerland and Hungary, Dresden and Würtemberg, at Ingolstadt, besides seventy-five or eighty other bridges built under the Monier system throughout Austria and Germany. Moreover, in all these countries everywhere concrete is used in the walls of dwellings and buildings of every kind and description, all of which bear witness to the unquestioned confidence with which the material is used.

In the cold sections of our own country and in Canada concrete has been extensively used, although it has not yet come into the universal use that it has across the water. This may be attributed to the lack of cement, which until recent years has been nearly all imported. In Halifax there are large docks and other extensive works that not only have to withstand the weather but must endure the wearing of heavy work. In Quebec and Montreal there is some fine work; and it is almost universally used as a paving material. In Northern Michigan, at Sault Ste. Marie, the walls of the canal and the locks were built years ago by government engineers in cold weather. The work has to withstand the wearing and chafing of vessels that are passing there constantly, and there is little or no wearing noticeable.

There are buildings in Minneapolis that are built entirely of concrete, some of which have been gutted by fire, but they are in as good shape to-day as when they were built, years ago. There are business blocks where all the wall faces and the ornamental work are of concrete, and it is regarded as a wholly satisfactory substitute for stone and is very extensively used. The same is true of St. Paul, of Milwaukee, Duluth, and other Northern cities, while an almost endless list of cities in the milder sections of the country would each contribute its testimony in the success of concrete for the hardest wear. In Chappaqua, N. Y., a building was built by Horace Greeley more than thirty years ago, and although made of an ordinary kind of concrete, it has stood the test of exposure and is as good to-day as when built. In Buffalo a large apartment house is being constructed entirely of concrete.

In cement stucco also, whether on lath or brick grounds, there is a great amount of evidence in England, Scotland, and on the Continent. In Milton, Mass., some years ago, a residence of one of the Colonial governors was pulled down, but it had existed upwards of a hundred years in good condition, and the stucco was only lime mortar on a lath ground.

There is no evidence of a good concrete weathering badly, provided the material has been properly handled. It is asked why it has not been used more, and the answer is, not that it is not fit to be used, but that it has always been too expensive. However, recent advances and improvements in mixing and manipulation have done a great deal in reducing its cost, until it is now able to compete with even the cheapest constructions. In combination with red brick and terra-cotta charming architectural effects may be secured, while for strength, durability, dryness, and rapidity of construction, it is unrivalled by any other material. Combined in many forms with iron, it may be adapted to numberless uses, in arches, domes, and beams. It is readily thrown into ornamental forms of many varieties, and presents a wholly undeveloped field in architectural effects. It is not a new material, and, with the great amount of evidence of its many qualities at hand, it is safe to predict a far wider and more extended use of concrete than has hitherto been known.

Ross F. Tucker.

AT a meeting recently held by English manufacturers of Portland cement an association was formed to prevent the adulteration of cement. In our next issue we shall publish the address of Mr. Robert Bevan (Messrs. Knight, Bevan & Sturge), who acted as chairman of the meeting, also the remarks of some of the other manufacturers.

The following is the call issued for the meeting:—

"2 Suffolk Lane, London, E. C.,
26th October, 1894.

"*Dear Sirs*, — We are desired to call your attention to the following circumstances seriously affecting the trade in which you are engaged: —

"It is becoming notorious that several Manufacturers of English Portland Cement are largely adulterating their manufacture by the mixture of Kentish Rag Stone, other stone, furnace or oven ashes, disused or exhausted firebricks, or other inert material, and so bringing disrepute upon the good name English Cement has hitherto borne in comparison for quality with cement of foreign manufacture.

"Such practices are so detrimental to the best interests of the cement trade, both by the discredit which is thereby attached to English manufactures, and the unfair competition in prices thereby rendered possible, that it is now proposed to establish an Association of English Cement Manufacturers for the purpose of dealing with and, if possible, putting a stop to a practice so unprincipled and disreputable, and so calculated to perpetuate an injury to the trade.

"We are instructed to inquire if you would be willing to join an Association of Cement Manufacturers for this purpose, and if so we shall be glad to hear your views on the subject, and to know if you would attend a meeting presently to be convened.

"We are, gentlemen,
"Your obedient servants."

IN an article by Mr. Hartranft, printed in our November number, reference is made in the table showing tests of the different brands of cements to the Whitaker cement. We wish here to call attention to the fact that this is the cement made by the Whitaker Cement Co., and sold under the brand of "Alpha" Portland Cement.

THE MASON CONTRACTOR.

A Department conducted in the interests of the Builder, and the Contractor for Brickwork.

SIDE TALKS WITH THE CONTRACTORS.

IN presenting the following the writer has endeavored to briefly discuss certain subjects of special importance to every practical builder, and in presenting the same he has been most particular to treat only such questions as shall be of especial interest to the modern, advancing man, who is always ready to leave the old ruts and listen to new ideas, although he may not be in harmony with some of the old mossbacks everywhere to be found, who insist in believing that the methods of the Pilgrim Forefathers are good enough for them.

The National Convention of the Bricklayers and Masons' International Union, now in session at New Orleans, La., will, before it adjourns, decide on many questions of great moment to the contractors.

This whole question of difference between the contractor and the men is one of the utmost importance to the industrial interests of the country, and at the same time a difficult matter to settle except by the measure of strength between the parties at interest. Many are apt to deplore the work of the unions, but they seem to be a necessity in the present condition of affairs, and, while in many cases much suffering, loss, and injury have resulted from the strikes occurring under the unions, yet I may note many instances where these unions have resulted in the material advancement of the trades they have represented.

For the last few years, however, the great question in agitation has not been so much the rate of wages as the hours of labor. On the part of all the unions, the reduction of the hours of labor from nine to eight seems to be the point at which they are aiming.

The grounds for advocating this reduction of hours are various. Some advocate it in order to distribute labor among a larger number of individuals, others on the ground that such a change will afford the laboring man better opportunities for mental improvement.

That the eight-hour movement will eventually prevail, I have not the slightest doubt. But to come back to the question of unions. It might be said this is an age of unions, both on the part of labor and the capitalists. Syndicates and corporations may represent our moneyed men, and labor unions our toilers, but both are hurtful or otherwise depending on their leadership, and no one suffers more from bad leaders and counsellors than the rank and file in either case. While it is right and proper for the workman to insist on his fair share of the profits of the enterprise in which he is engaged, yet efforts to reduce hours prematurely or increase wages beyond their worth has only resulted in disaster to the very interests that they seek to benefit.

The same again is likely to prove true where the greed of capital seeks to grind the workman to the earth.

In these days of great enterprises there must be a recognition on either side of the just rights of the other, and with such a recognition the constantly recurring labor troubles would be largely avoided.

WITH HIGH BUILDINGS arises a question of good foundations, especially when they are built alongside old buildings two or three stories high. The greater weight of the new and high building is apt to crack the old building and damage it, and great care should be used in building to prevent the settling of the new building from injuring the adjoining property. Should any damage be done the old building, the proprietor of the new structure will be held responsible, and he in turn will look to the contractor for redress, so I would recommend not only care in the foundation of the new building, but that the adjoining buildings be photographed to a large scale before any work is done on the new building, so that their condition might be on record in the event of a claim for damages. These photographs should be taken under the charge of one well acquainted with the building, and should be not only the back and front, but the side and parts of the buildings adjoining the new one. Often there are cracks in these side walls, and they ought to be photographed. One may laugh at the idea of photographing a crack, but it is sometimes very necessary, and I have seen the owner, who was claiming that the new building had damaged his property, look very queer when a photo of that same crack was shown, proving that it was there before the new building was erected. I have seen photographs introduced in court on a trial in regard to a building contract, and can appreciate the effect on a jury. The photograph can produce indisputable facts, and its possibilities should be borne in mind by contractors.

SCAFFOLD BUILDING is a question that is becoming of great importance in the crowded thoroughfares of a large city. In the first place, a scaffold which is to hold and support a system of staging must, first of all, be of sufficient strength for its purpose; second, occupy the space required for its supports in such a manner as to not impede the progress of pedestrians or the movement of merchandise; and, thirdly, it must be portable, easily put together and taken down, and be removable without injury to its parts. Most of us are familiar with the methods of scaffold building in general use, particularly the wasteful method of splicing timbers together and bracing them with boards, and the universal reliance placed upon the holding power of a nail or spike, and many of us have witnessed the wholesale destruction of lumber which takes place when such scaffolding is removed.

Many of us also are acquainted with the light iron skeleton framework composed of interchangeable members, fastened with collars, screws, or clamps, or other mechanical devices, and it is this type of scaffolding that is needed in large cities rather than that of timber construction, for timber is becoming scarce and its constant renewal is not the only source of expense entailed by it. The storage of large pieces of timber in cities like New York and Boston is growing more burdensome each year; the extra cartage, too, on such bulky materials is another item of importance to be considered, so that, when all of these factors in the cost of scaffolding, including its maintenance, are added together, the sum amounts to so much that new methods and devices have at last been forced upon builders and contractors. In addition to the question of cost is that of the personal safety of the builders themselves. Strange as it may seem, the element of personal safety, either to his men or to himself, seldom enters into the calculations of a contractor, for his business is attended constantly with more or less personal danger, and to a certain extent he has become used to it, and for that reason it is almost needless to urge any consideration of the subject upon that ground. Although there is a vast amount of conservatism in the modern contractor about trying new methods, there is one point upon which he is equally sensitive with other men, viz., upon the question of increased profits, and it is to this phase of the new methods in vogue that his attention is commended.

BRICK BUILDINGS in almost all cities are from time to time disfigured by streaks and patches of white. The evil is most noticeable in dry weather on parts of walls subjected to dampness, and on entire walls after rainstorms have soaked them. The white coating is derived primarily from both the bricks and the mortar. In some instances it undoubtedly comes from the bricks; here the white substance is dissolved by moisture from the bricks even before they are built into the walls, in fact it can sometimes be seen on bricks fresh from the kilns. It has a peculiar taste, that of sulphate of magnesia, but besides this salt the bricks also contain sulphate of lime.

The theory is that the silicates of magnesia and lime in bricks are converted into sulphates by the sulphuric acid evolved from the sulphite of iron and iron pyrites contained in the coal employed in the kilns.

Now sulphate of magnesia effloresces in dry air, and sulphate of lime is dissolved by moisture and appears on the surface of the bricks. Hence, plainly, one mode of preventing the incrustation is the employment of only wood, or of coke free from sulphur, in the kilns; at least this might be done in the manufacture of pressed brick for house fronts.

As for the incrustations having their origin in the mortar comes from the fact that sulphate of magnesia is largely produced by the decomposition of mortar. The observations on this head have special applications to vicinities where most of the lime used in buildings is from magnesia limestone.

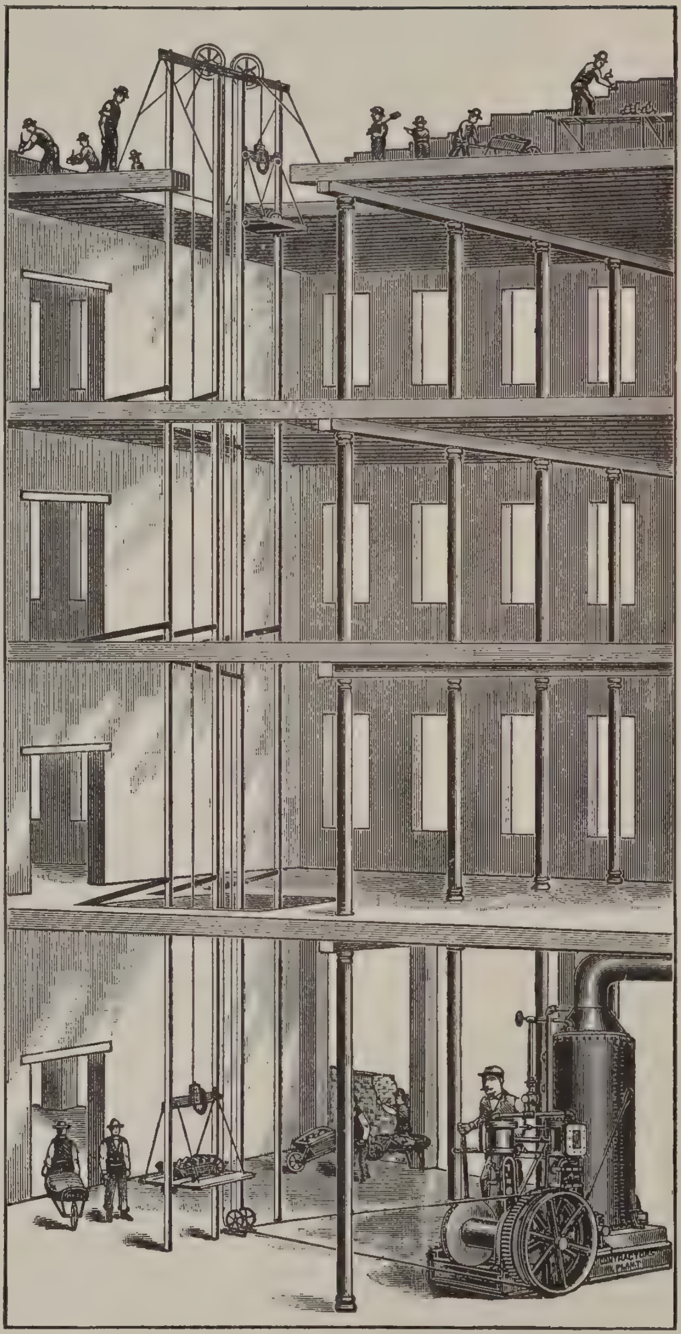
The resulting mixture of limestone and magnesia when slaked and made into mortar is very susceptible to the influence of sulphurous fumes in the atmosphere, which produce in the mortar sulphates of lime and magnesia.

The great solubility of magnesia facilitates its diffusion; sulphate of lime is comparatively insoluble, and does not cause so much disfigurement. Of course mortar made from magnesia limestone quickly decomposes, and the brick it was intended to cement becomes loose. The remedy for this is the employment of lime from non-magnesia limestone. The remedy also offered for this evil is the addition of a small quantity of baryta to the water used for tempering the brick clay. The baryta having a strong affinity for the free acid would seize upon it and with it form insoluble sulphate of baryta. A like addition of baryta to mortar after it is prepared for use may reasonably be expected to check the tendency to efflorescence, except, of course, when the mortar, as in chimneys, is continuously exposed to sulphurous vapors. The white patches may be washed off with simple water, then use linseed oil as a coating, which is an excellent treatment. The best success has been attained when diluted muriatic acid has cleansed the pores in the bricks and thus permitted the oil to penetrate farther into the bricks and keep the wall dry.

Dampness in the walls of large buildings is a constant source of annoyance in many instances and is generally caused by the presence of water in the atmosphere and soil combined with the porosity of building materials which absorb it. Its effects are to cause disintegrating of masonry, the decay of timber, the development of saltpetre on walls, and injury to the health of the inhabitants of the buildings, with damage to the decorations of walls and furniture. Remedies to prevent and cure it may be applied to both the causes by, first, employing suitable materials for cellars and other parts of buildings below or on the level of the soil; second, inserting damp-courses to stop the upward progress of dampness; third, applying preparations to protect the face of the exposed wall from the weather, or to prevent damp in the wall from affecting an apartment; and fourth, adopting precautions against infiltration. Concrete covering the whole ground area of the future building with a layer four inches thick forms the most sanitary foundation. It is usual, in order to keep the walls dry, to have near the ground level a course which is called a " damp-proof course," and for this purpose asphalt may be used, or a double course of slate bedded in Portland cement. The asphalt should be spread about one half inch thick (and sprinkled with coarse sand), and of the best quality, and there may be no fear as to the compressibility of the asphalt of that thickness from the heat of the sun in the summer time on account of the proximity of the soil and the alternation of temperature of day and night. And there can be no question that the construction of masonry below the ground line of buildings should be done in hydraulic cement mortar, as an effectual means of preventing the ascent of humidity in buildings.

Dampness is said to prevail most in buildings finished hastily, because the materials which compose the walls, having never been dry, conform themselves to the humidity rising in a regular current by capillary attraction, never allows the possibility of the walls becoming dry.

R. N. Buell.



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THE MANUFACTURER.

ENAMELLED BRICK.

THERE is perhaps no one product in general use that so distinctly marks the progress of a nation's growth and wealth as its clay products, in their various forms. Steel is a wonderful factor in the construction of the larger modern buildings, but *its* skeleton has to be clothed with the production of the clay-worker, and for exterior uses (as well as interior) there is no doubt but that enamelled brick will take front rank in the future for this purpose, especially when it becomes known that all the beautiful designs in architecture and harmonious blending of colors are attainable in this class of work, to which is combined durability, beauty, and freshness for all time. While great strides have been made in this country in the manufacture of common and pressed brick, paving brick, terra-cotta, roofing tiles, etc., the enamelled brick industry has not kept pace, and is in its infancy, chiefly on account of the greater difficulties involved in the manufacture of this specialty, so that hitherto most of the needed supply has been imported at large cost from England; but within the past year Chicago has added this industry, in all its completeness, to her former productions, so that the projectors of such structures as the great Marquette and Reliance buildings were able to procure the immense quantity of enamelled brick required for these structures right at home, and no finer enamelled work can be found in this city or elsewhere.

The true enamelled brick is just as good for external as for interior use. They stand the most severe and sudden climatic changes, and may be used in any climate and in any situation.

It is a surprise to any one visiting England to see the variety of purposes for which enamelled bricks are being used in that country. The approaches to their railway stations, exterior of buildings surrounding the platforms, booking offices, waiting-rooms, toilet-rooms, etc., are worked out in patterns and beautiful designs of different colored enamelled bricks. They are used also in the large hotels and stores, post-offices, banking and insurance offices, factories, engine-rooms, cemetery vaults, stable interiors, and also in the underground railways. Enamelled brick have won such favor in England that the municipality of London requires that all courts and alleys be lined of this material. It reflects light, is fireproof, acquires no odor, is impervious to moisture, and forms a finished surface which is highly ornamental.— *Inland Architect and News Record.*

HORTICULTURAL HALL, Philadelphia, Pa., which was destroyed by fire several years ago, will be rebuilt at once, in accordance with the designs of Architects Frank Miles, Day & Bro. The new building will be a very elaborate affair, in the style of the Italian Renaissance, built of brick and terra-cotta with tile roof.

A novel feature of the exterior, which is quite a departure from the usual methods, will be the frieze of the main building. It will be four feet high and about three hundred feet long, modelled in bold relief and treated in color, similar to the work done in the time of Raphael; this frieze will be made of terra-cotta.

The interior will furnish accommodations for the Floral Club and the Horticultural Society; there will also be large rooms for balls and banquets, a hall for lectures, and the required anterooms; the main hall will be elegantly finished in marble and will contain a grand stairway of the same material; the interior finish will be principally of marble and mahogany.

The work will be ready for bids about Feb. 1.

THE name of Akron's new mayor is Erastus R. Harper, and an excellent man has been chosen to fill the vacancy occasioned by the resignation of Lorenzo Dow Watters from that office.

Mr. Harper, who is one of the most prominent and substantial business men in this city, is thirty-seven years old and resides at 108 Franklin Street. He was born in Independence, Ohio, and came to this city fourteen years ago. Since that time he has become prominent in business circles, and has always taken an active part in politics. Mr. Harper is at present identified with many of Akron's business concerns, being secretary and general manager of the Akron Vitrified Pressed Brick Company, a director of the Akron Building and Loan Association, and president of the Citizens' Club. — *Akron Beacon.*

THE beautiful white clay from which the brick of the White Brick and Art Tile Company is made is mined on the site of their plant at Clayton, Mass. The plant is equipped with the Boyd presses and has eight kilns. It is particularly well located for the New York and New England markets, being on the lines of the New York, New Haven and Hartford and the Pennsylvania and Reading roads. This brick was recently specified by Bruce Price for the palatial residence of George Scott, Esq., at Newport.

THE ATWOOD FAIENCE COMPANY have completed their new plant in Hartford, on the line of the New York, New Haven and Hartford Railroad, and have already enough orders to start kilns. The factory is a model one in every respect. Mr. Atwood is well known as having been at the head of the Fiske, Homes & Company Faience department. With his well-known energy and ability, we look to see some of the best results ever obtained in this line of clay art.

PHILADELPHIA, PA. — The Conkling-Armstrong Terra-Cotta Company has been incorporated by Ira L. Conkling, Thomas F. Armstrong, Edward N. Conkling, Samuel O. Conkling, Thomas Armstrong, Albert R. Taylor, William H. Bell. Capital stock, $60,000. A permit has been taken out for the erection of a factory building on Wissahickon Avenue, and the work of erecting will be commenced at once. The main factory will be 60 by 160 feet, and will be two stories high, with a wing 45 by 90 feet.

THE THURMAN FUEL OIL BURNER COMPANY, Indianapolis, Ind., have issued a new catalogue of their burners that should certainly interest any parties who are agitating the question of economical fuel. The pamphlet treats the subject very directly and to the point, and contains a number of strong indorsements from parties who have used the Thurman burner with gratifying results.

THE YALE BRICK COMPANY, of Berlin, Conn., are making a splendid front brick in various colors. Mr. Yale has a system of his own for dampening the fine clay as it is fed to the press, and the results prove his invention to be a success.

THE STEPHENS COMPANY will succeed Stephens, Armstrong & Conkling as the Philadelphia branch of The New York Architectural Terra-Cotta Company.

GALVESTON, TEX. — The American Dry Dock Company, 524 Tremont Street, want bids on 1,500 barrels of best Portland cement.

SALINA, KAN. — The Acme Cement Company have removed to St. Joseph, Mo.

CEDAR GROVE, W. VA. — The Cedar Cliff Cement Company is building a new mill.

MINNEAPOLIS, MINN. — The Minneapolis Cement Company has been incorporated.

RECENTLY INCORPORATED.

Chicago: Rogers, McDonald Pressed Brick Co., $250,000. Samuel W. Bradford, Atlee V. Cole, and Frederick J. Patterson. — Des Moines, Ia.: The Capital Brick and Pipe Co., $100,000. John B. McGorrisk, pres., D. W. Wooden, V.-P., E. H. Conger, Sec. and Treas. — Baltimore, Md.: The Druid Brick Co., $40,000. Nicholas C. Penniman, Wilmer L. Keller, Frank Debelvis, Griffith Cook, and George C. Harding. — St. Louis, Mo.: The Mount Pleasant Brick and Quarry Co., $40,000. H. R. Becker and others. — Milwaukee, Wis.: The Rameses Earthen Ware Co., $150,000. James Douglas, Andrew S. Mitchell, and Thomas K. Ewing. — New Brighton, Pa.: American Porcelain Co., $50,000. Thos. E. Marshall, Frank S. Reader, J. S. Boyd, Thos. Craven, and Sam'l L. Marshall. — Alexandria, La.: The National Terra-Cotta Co., $100,000. David N. Saum and others. — St. Louis, Mo.: The New Haven Pipe Co., $100,000. A. S. and A. E. Speirs, James Smith, and Wentworth Terry. — Oakes, Pa.: The Pennsylvania Enamelled Brick Co., $100,000. — Terre Haute, Ind.: The Terre Haute Mosaic Tile and Marble Co., $10,000. E. J. Norris, Harry Duxler, P. C. Kintz, D. M. Hessler, P. A. Bowsher, M. E. McCan, and J. W. Landman. — Mechanicville, N. Y.: The Best Brick Co., $10,000. A. B. Orcutt, Jones B. Orcutt, Wm. N. Carey, Ezra W. Swartout, and H. E. Barton. — Roaring Branch, Pa.: The Ralston Brick Co., $50,000. — Indianapolis, Ind.: W. G. Wasson & Co., cement and lime. — Phillipsburgh, N. Y.: Phillipsburgh Cement Works, $300,000.

San Antonio, Tex. — The San Antonio Pressed Brick Company has been organized by Jacob Leonardt, of St. Louis, as president, and others, and will erect a plant for the manufacture of pressed brick. Work on the latter will commence at once. The machinery will cost $20,000.

Southampton, N. Y. — The Southampton Brick and Tile Company has been incorporated by William T. Graham, William F. Halsey, William N. Seely, James E. Jennings, and H. M. Howell, of Southampton. Capital stock, $10,000.

Washington, D. C. — The National Terra-Cotta Siding Company has recently been organized to manufacture the new building material known as "terra-cotta siding." The plant has been located, the machinery to manufacture developed and purchased, which is now on its way to this city, and more than half a million feet of engaged sales of its product secured.

Washington, D. C. — The Washington Brick and Terra-Cotta Company have been granted permit for the erection of a brick-burning kiln on Delaware Avenue, between O and P Streets, Southwest. It will be 55 by 55 feet, and built by P. S. Yougren.

Philadelphia, Pa. — Webster, Gillespie & Co., brick manufacturers, have put their plant in operation, with one hundred additional workmen, and are prepared to work every day through the winter that the weather will permit. They report trade to be in a flourishing condition.

SITUATION WANTED.

An EXPERIENCED MASON FOREMAN wishes a situation as foreman or inspector of mason work. Will work anywhere and is experienced in buildings, railroads, and marine masonry. Refer to the editor of this paper. Address

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In no single detail of its *simple*, *powerful* and *ingenious* mechanism is this press susceptible of mprovement. We are also manufacturers and dealers in full brick-yard equipments, and are orepared to estimate on and construct complete plants. We are also prepared to test all bricknaking material sent to our address in Chicago. For prices, terms and other information, address,

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THE
BRICKBVILDER

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85
WATER
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BOSTON

BRICK AND MARBLE IN THE MIDDLE AGES.

G. EDMUND STREET.

CHAPTER VIII.

(*Continued.*)

IF we return to the nave, we shall find that it is not only in general effect it is so very worthy of admiration; it still retains much of its old furniture, and, in spite of a few modern mosaics, and one or two more modern altars, is less altered in its general effect since the fourteenth century than any great church that I have ever seen. The screen between the nave and choir with the ambons on either side of it first deserve notice. The screen is mainly a work of A. D. 1394.[1] It consists of a series of columns carrying a flat lintel or cornice, on the top of which is a row of extremely good statues of the apostles. They have that grand sweep of the figure which one knows so well in early fourteenth-century work in France, and are free from the somewhat heavy and clumsy treatment which marks so much of the work of the Pisani. The screen has been raised on the base of the older Byzantine screen, which consisted of a simple continuous arcade now nearly hidden by the more modern steps to the choir. The ambons are probably of the same age as this older screen; the gospel ambon being of two stages in height, with a good staircase to it from the choir aisle, that for the epistle being comparatively low and simple, but still large enough to contain two or three modern pulpits. The screens to the choir aisles are of the same sort as the main screen, but are placed one bay to the east of it. They are all three interesting as showing that a Gothic architect could use with good effect a common Classic arrangement, and indeed lend fresh grace to it by the detail of the sculpture and inlaying with which he adorned it.

Dimly seen from the nave through the rood-screen, but far more interesting than even it, is the great baldachin or canopy over the altar in the choir. Here we have the simplest form — four columns carrying round arches, and the wall above them finished with a plain horizontal capping. The arches may be modern, though if they are so, they are copied from the old, as is evidenced by the painting at the back of the Pala d' Oro, which shows the placing of the shrine of St. Mark under a similar baldachin; but the groining is old, and the alabaster columns are of extreme interest, being covered all over with most elaborate sculptures of Scripture subjects. The subjects in the northeast column give the history of Joachim and Anna, and the birth of the Blessed Virgin Mary; the northwest has the nativity of our Lord, the marriage in Cana, etc.; the southwest, subjects from the Passion; and the southeast the miracles of our Lord. Few modes of decorating an altar are altogether so fitting and beautiful as this, and I hope the day is not far distant when we shall see many of our English altars standing under canopies of the same sort. St. Paul's Cathedral may well prepare the way for us in this, by reviving what was usually accepted as the best kind of reredos by our English church-builders in the eighteenth century.

Here, too, is a brass eagle so like one of our own that one might almost give it credit for coming from an English smith or founder.

Returning to the nave, one finds nothing more worthy of admiration than another smaller baldachin over an altar between it and the north aisle. This is hexagonal, carried on shafts with stilted arches and roofed with a steep roof. Its dimensions render a small altar a necessity,— a matter of common occurrence in old examples. Another reredos and altar in a chapel at the north end of the north transept, dating from 1430, may also be noticed. Here the altar is panelled in front and carved with two angels censing a cross, and low open screens with arcades carried on shafts are placed a few inches from the ends of the altar. The footpace is not carried round the altar, so that it can only be approached from the front.

Of another sort of furniture — monuments of the dead — St. Mark's has, as might be expected, a good many examples. The earliest are the probably Roman sarcophagi,[2] which lie in the outer aisle or cloister, right and left of the entrance; the next, near them,[3] where the sarcophagus is still retained, but adorned with Christian emblems and sculpture; and of considerably later date, and much more artistic interest, are the tombs of the Doge Andrea Dandolo and of Sant' Isidoro. Here the sarcophagus is surmounted by a canopy, reverent angels stand on either side drawing back partially the curtains from the front of the effigy, and in the centre of the tomb is a bas-relief of the Madonna, and at the ends the Annunciation, St. Gabriel on one side, the Blessed Virgin Mary at the other. This is the type of monumental memorial on which so much of the time of Venetian sculptors seems to have been spent. Here, indeed, and on the very similar figures of the Virgin on so many of the tympana of doorways throughout the city, we have to study the sculptor's art from the time of the Byzantine carvers who wrought the still numerous early capitals, until the artist of the Ducal Palace came to revive the art with his original and splendid series of capitals.

But of all the features of this grand church, that which, next to the gorgeous color of the walls, most attracted me was the wild beauty of the pavement. I know not what other word to use which quite describes the effect it produces. It is throughout arranged in the patterns common in most Opus Alexandrinum, but, instead of being laid level and even, it swells up and down as though its surface were the petrified waves of the sea, on which those who embark in the ship of the church may kneel in prayer with safety, the undulating surface serving only to remind them of the stormy sea of life, and of the sea actually washing the walls of the streets and houses throughout their city. It cannot be supposed that this undulation is accidental, for had it been the consequence of a settlement of the ground we should see some marks of it in the crypt, and in the walls, and some tokens of disruption in the pavement itself. And the corresponding example of Sta. Sofia, Constantinople, where we have it on record that there

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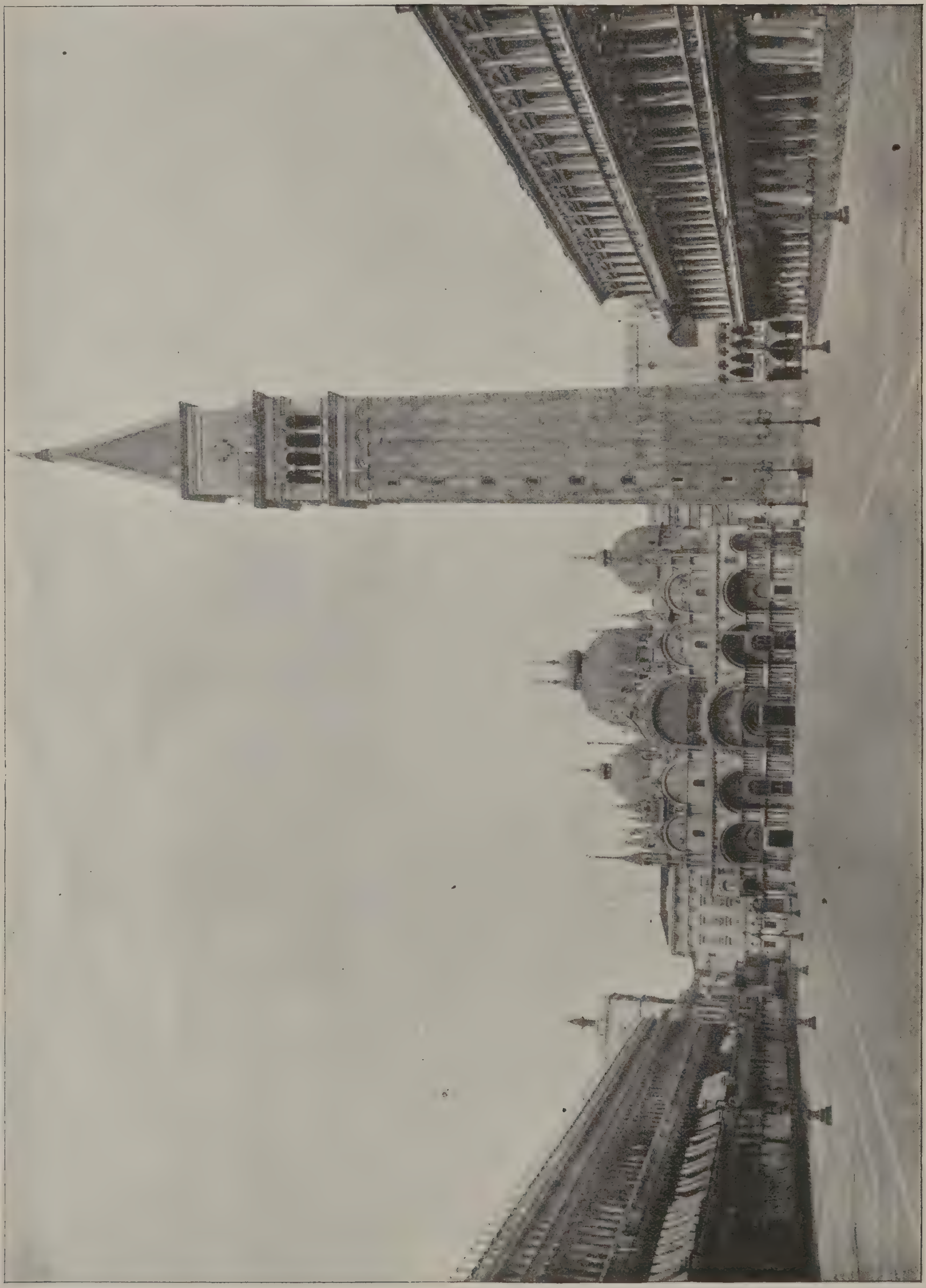
[1] The inscription on the screen, which gives the date and the name of Doge Antonio Veyerio, gives also the names of the sculptors.

[2] The tomb of Vitale Faliero and another.

[3] The tomb of the Doge Marino Morosini.



PIAZZA S. MARCO AND CAMPANILE, VENICE.

Supplementary Illustration to "Brick and Marble in the Middle Ages."

was an intentional symbolism in just such a floor, is conclusive as to the intention of its imitators here.

Of the mosaics with which the church is richly adorned I cannot pretend to give a complete account; they deserve a volume to themselves. As regards choice of subjects, it is noticeable that the most prominent figure is that of our Lord, who is seated, and surrounded by prophets. Below are the emblems of the four Evangelists, and the four rivers of Paradise. Whilst again, in the west dome, He is surrounded by the Apostles and the Evangelists, and everywhere the general scheme is a lesson to those who, nowadays, too often forget the relative importance, or the proper order and arrangement of the divine story, in the schemes they adopt for stained glass and mural decoration. As regards color, I need not repeat what I have already said; but it may be observed that wherever modern mosaics have taken the place of old ones, there at once we see a complete collapse, and a loss of all good effect. This is mainly owing, beyond doubt, to the attemp which their designers made to produce the effect of pictures, instead of thinking first and mainly of the decorative effect of their work on the building. But, at the same time, it is obvious that their eyes had lost all feeling for good color, and that in attempting to draw with a certain amount of academical accuracy they had equally lost all sense of the prime necessity in such works of simplicity of arrangement, and directness in the telling of their story. There is no part of the church in which some of the best of this sort of decoration can be studied with more ease and advantage than in the cloister on the north side of the nave. Here the mosaics are so near the eye and the details of design and color so fine that one is never tired of admiring them.

I never leave St. Mark's without taking one look at least at the four bronze horses, which, placed as they are on columns high above the ground, add so much to the strange character of the west front, and are in themselves such exquisite examples of their kind. Strange ornaments these for the façade of the chief church of a city where horses' feet have hardly ever trod! Equally strange, if you are to have horses in such a position at all, is the way in which these are supported. They stand balancing themselves nicely on the caps of small columns. Extremes meet; and I am not so sure but that this extraordinary arrangement is not better than that which is usually adopted. If horses are to be supported above the ground, they may almost as well be so in this way as on the ordinary pedestal, which looks equally unsafe if the bronze is instinct with life. These horses were brought from Constantinople after the fourth Crusade, circa 1203. They are of admirable character, and are probably of Greek workmanship. With every other movable thing worth moving, they were taken to Paris, and returned after the Peace in 1815.

There is a picture in the Accademia by Gentile Bellini which ought to be looked at after a visit to St. Mark's. In it we see the church much as it is at present; but an enormous procession which winds its tortuous way about the piazza defiles before houses every one of which seems to be ancient, and I never look at the now uninteresting lines of houses which surround it without wishing for the resuscitation of the buildings which Gentile Bellini saw and drew.

We went into the treasury to see the treasures and plate belonging to the church, but I was much disappointed to find that, in an artistic point of view, there was really very little to admire, or else what was admirable was not shown. The treasury is a dark room lighted up by a few wax candles, but so badly that it was difficult to see at all satisfactorily.

I was unable to obtain a sight of the Pala d' Oro, as the altar piece behind the high altar is called; it is only uncovered on feast days, and I have never happened to be in Venice when it was visible. I was very anxious to have seen it, as it is a most magnificent piece of workmanship in gold and enamel. It was executed in Constantinople, and brought to Venice in 1102. Some Italian writers have claimed it for their forefathers as an Italian work; but the documentary evidence of its Eastern origin is supported by the details of the design and execution of the earliest portions of the work. M. Durand has published a very careful description of it in the "Annales Archéologiques," Vol. XX. He gives a list of no less than one hundred and sixty-nine panels or figures, in a considerable number of which the accompanying inscriptions are in Greek characters. The Pala was "restored" in the thirteenth century and again in the fourteenth, when no doubt considerable additions were made to it. The painting at the back has fourteen subjects on a gold ground, and is dated 1345.

Over and over again, when at Venice, must one go into St. Mark's, not to criticise, but to admire; and if ever in any building in which the main object is the study of art, assuredly here one must go for worship also. I think I never saw an interior so thoroughly religious and religion inspiring as this, and it is well, therefore, not lightly to pass it by as useless for our general purposes. It seems to show, as strongly as any one example can, how much awfulness and grandeur of character even a small building may attain to by the lavish expenditure of art and precious materials throughout its fabric; for it is to this that St. Mark's owes its grandeur, and to this only. There is nothing imposing either in its size or in its architecture; on the contrary, they appear to me to be both moderate, and the former rather mean; and yet this grand display of mosaics upon a gold ground makes the building appear to be both larger and better than it is, and fully atones for all other defects. Could we but place one of our cold, bare places of worship by the side of St. Mark's, and let the development of Christian art in the construction of the fabric be ten times as great in our Northern church as in the Venetian, we may yet rest assured that every religious mind would turn at once to the latter, and scarce deign to think of the former as a place of worship at all. If this is so, does it not point most forcibly to the absolute necessity for the introduction of more color in the interior of our buildings, either in their construction or afterwards by the hand of the painter? And architects must remember that this ought all to be within their province as directors or designers, and therefore that they must not, as now, venture to design cold shells which may or may not afterwards receive these necessary and indispensable decorations, but from the very first must view them as part and parcel of the work in which they are personally concerned; and then, but not till then, shall we see a satisfactory school of architects in England.

The interest of St. Mark's is not, however, only religious and artistic, on other grounds it is certainly one of the buildings most worthy of study in all Europe. Its architecture is purely Byzantine; and whether its design was derived from Constantinople or from Alexandria, it presents us with an almost unique example of the architecture of the Eastern Church transplanted almost without alteration to the domains of the Western. Nor is this all; it played no small part in modifying the distinctly Roman influence by which otherwise the whole of Northern Europe would have been affected. When we see a church so far from St. Mark's as that of St. Front at Périgeux modelled after it, and in its turn influencing a vast number of churches in that and the neighboring districts, we may realize what St. Mark's did towards the development of Romanesque into new forms and combinations, and may then value properly every portion of its fabric. Byzantine architecture was the development of Greek art in the hands of the then vigorous and active Eastern Church. It is not a direct reproduction, therefore, of Classic art which is to be seen in St. Mark's, but one stage of a development the influence of which — partly owing to the effect of commerce, partly to her isolation — was largely felt down to the very last days of active Venetian artistic life. This has been well condensed in a short sentence by Mr. Ruskin. "All European architecture," he says, "good and bad, old and new, is derived from Greece through Rome, and colored and perfected from the East. The Doric and Corinthian orders are the roots, the one of all Romanesque buildings, — Norman, Lombard, Byzantine; the other of all Gothic, — early English, French, German, and Tuscan. The old Greeks gave the shaft, Rome gave the arch. The Arabs pointed and foliated the arch." But in the coloring and perfecting the church of St. Mark had the lion's share, just as in the ground plan it is to Venice and the East that we owe the cruciform arrangement of so many of our buildings, instead of the basilican form, to which we might otherwise have been condemned.

(To be continued.)

THE ART OF BUILDING AMONG THE ROMANS.

Translated from the French of Auguste Choisy by Arthur J. Dillon.

CHAPTER II. — *Continued.*

II. GROINED VAULTS. — *Continued.*

PERHAPS the desire for variety in architectural compositions sometimes caused the adoption of groined vaults when they were not imposed by the exigencies of construction, but the cases where they were adopted through motives other than those relating to art of building are rare, and almost everywhere we will find that, aside from the æsthetic reasons, their use was justified by those of a material order. We have, however, rather to indicate the means employed by the Romans in planning and constructing groined vaults than to discuss the cases where they were used; let us first consider their forms.

The Romans, in all cases, having a marked preference for simple solutions, endeavored to reduce their groined vaults to those formed by the intersection of barrel-vaults of equal width, for they could then give the barrel-vaults a circular form and avoid, at least in the transverse principals of centring, elliptical curves. To be exact, the Romans seldom bound themselves to give an absolute equality to the diameters of two intersecting barrel-vaults; if there was a slight difference between them they neglected it, and contented themselves with placing the summit of the vaults at the same level, keeping them circular. It was in this manner that the central hall of the Basilica of Constantine was vaulted.

The radius of the larger vault, C D (Fig. 39), was taken as the common height, and the smaller, also semicircular, was stilted, so that its total height A B was equal to C D. This slight stilting, which was necessary in the smaller of the vaults, was far from injuring the appearance of the edifice, for it gave it, on the contrary, an air of great elegance.

But the inequality of the sides of a hall was often so great that this expedient was not applicable, and then it was sought by means of a simple artifice to make the construction that of a vault on a square plan (Fig. 40). Thus only a square, A B C D, in the central part, made by taking A D and B C equal to the smallest dimension A B, was covered by a groined vault, while the remainder of the rectangle was covered by the extension, as A E of the longitudinal barrel-vault. This solution was quite common, but it must not be considered as universal, for it would be untrue to say that the Romans entirely excluded groined vaults of unequal sides and the resulting elliptical barrel-vaults. There is, for instance, a nearly intact hall in the Baths of Diocletian, which has three bays covered with groined vaults where the relation between the diameters of the intersecting barrel-vaults is about as two is to three. (Fig. 41, plan, and Plate IX., general view.)

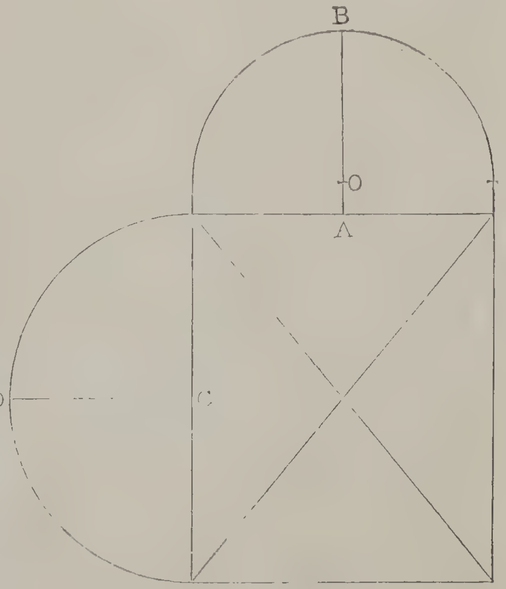


Fig. 39.

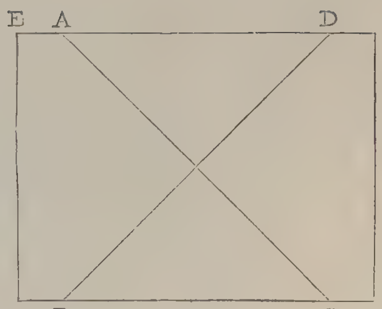


Fig. 40.

This vault is frankly *barlongue* and it is, moreover, the most remarkable instance known to me of a groined vault over a lengthened rectangle, but it is by no means the only existing example. The elliptical forms were not put aside until the time when the architects of Constantinople, the inheritors of the traditions and tendencies of the Roman art, thought of substituting for the classic groined vaults the eminently practical solution in Fig. 42.

Thanks to this ingenious arrangement of the vaulting, the more or less irregular form of the plan ceased to be a cause of complications in the intersections. There might and might not have been a difference in the length of the sides, or the plan, at need, might have been a quadrilateral with unequal angles, but in every case the curves of the intersecting vaults would be semicircular, and the groins themselves were arbitrary, so that there was nothing to prevent their being drawn with the compass; and full centred principals only were necessary for centring. But here it is sufficient to indicate the relation between this Byzantine innovation and the Roman ideas; and we will again take up the question of ancient groined vaults, regarding them from the point of view of the methods of construction.

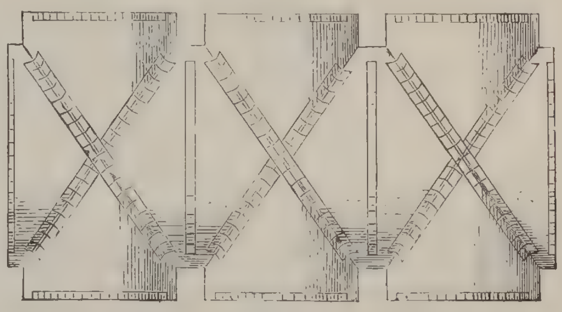


Fig. 41

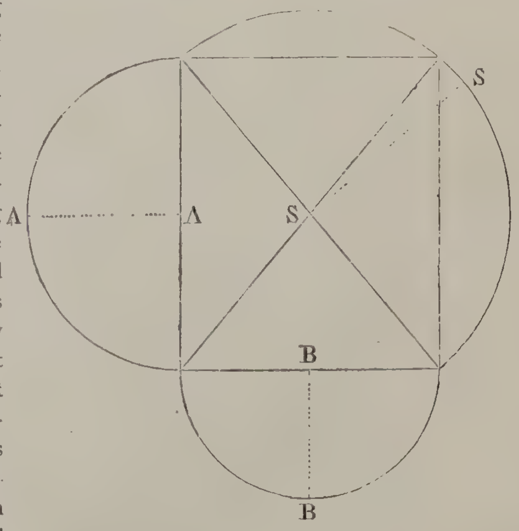
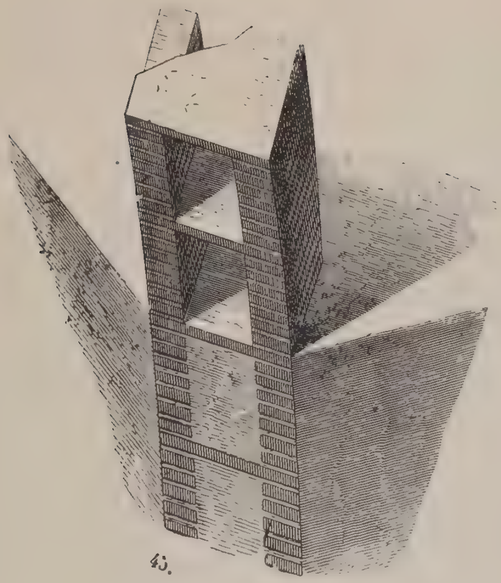


Fig. 42.

Whatever may have been the admitted forms of the groined vaults, the Romans facilitated their establishment by the employment of processes very similar, at least in principle, to those which were developed in considering barrel-vaults. Both were composed of two distinct parts, — the mass of rubble which formed the body of the vault and the open network or thin lining of brick which served as a support for the rubble during the construction, and was at least a partial substitute for the temporary centring which would otherwise have carried the load.

When they used the system of armatures of flat laid bricks, the



43.

Romans took care to protect the groin by a solid rib; small as the bricks might be in the rest of the lining, those along the groin were never less than forty-five centimetres on a side, almost always sixty centimetres, while their thickness was about five centimetres. The greater part of these tiles at the angles have disappeared, but their imprints, which still remain, clearly show their size and form, and one can easily realize the general appearance of the armature. Seen from above, before the laying of the rubble, it had the aspect shown above (Fig. 43), which is taken from one of the halls in the Baths of Caracalla. The same arrangement, moreover, with some slight variation, is to be found in Hadrian's Villa, the Palace of the Cæsars, etc.

The method of support by means of ribs was still more easily applicable to the exigencies of penetrating vaults. Ribs M and N (Plate IX.) were placed along the lines of intersection, and, if there was need, other secondary ribs (R) were thrown transversely from one pier to the other. But as these last differed in no way from the engaged arches used in barrel-vaults, I will confine myself to the construction of those along the groins (Fig. 44).

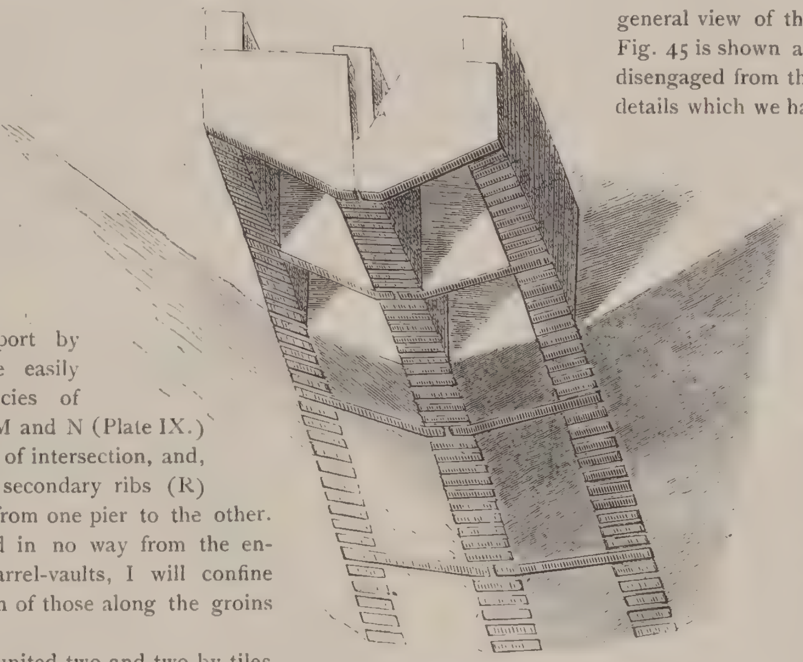


Fig 44

Three parallel arches united two and two by tiles formed, as it were, a solid backbone along the groin. It was necessary in order to place the bricks here to cut them to a certain extent in order to adjust them to the salient angle; but in place of cutting them in a regular manner by means of templates, the Romans contented themselves by clipping them as they were laid; and this was done in such a rough manner that it caused neither expense nor delay.

The only delicate operation was to construct the crossing of the diagonal ribs at the summit. There was no difficulty in closing one of the arches; M (Plate IX.), for instance, could be finished, but when it came to completing the other one, N, a complication arose, for the halves would press on the sides of the hollow rib M and threaten to crush it. Evidently it was necessary to fill with rubble the upper cells of the arch M before placing the last bricks of N, for when they were filled they were able to resist the crushing tendency, and the work could be completed without the slightest hinderance.

The great vaults in the Baths of Diocletian were constructed in this manner; and the usual method adopted for halls whose width was fifteen metres or more is of this type. In vaults of the smaller size the means of support were made less and less strong, and we will see the frame of brick simplified by degrees and its strength made proportionate to the efforts exercised on it by the mass of rubble. Following the logical sequence of the possible modifications, the Romans would have been led first to the suppression of the ribs R (Plate IX.) which cross the barrel-vault transversely; next to doing away with one of the three arches along the groins, and then two, thus reducing the armature to a single rib along each groin; and Roman architecture presents in this way all the intermediary steps between groined vaults with complete armatures and vaults with none whatever. We will endeavor to show by examples some of the different aspects which the skeletons of brick presented at different stages of this series of progressive transformations.

1. The form of armature which corresponds the closest to that which we have chosen as the type exists in a gallery of the Palatine near the southern angle of the hill (Plate VIII.). The diagonal arches are built exactly as in the Baths of Diocletian. There is the same number of elementary arches, and the method of obtaining a tie or bond between them is exactly the same, but in the Palatine the transverse arches were regarded as superfluous on account of the smaller size of the hall, so that it is exactly the combination shown in Plate IX., omitting the arches R which divide the vault into rectangular bays.

2. As an example of the diagonal ribs made of only two elementary arches I will cite only the groined vault in the central part of the so-caleld Portico of Janus Quadrifrons at Rome. A general view of the vault is given in Plate VII., and in Fig. 45 is shown a fragment of one of the diagonal ribs disengaged from the rubble which encloses it. After the details which we have already given it is hardly necessary to speak of the method of construction; one of the diagonal arches was built without considering the other; then two or three of the cells at the crown were filled and the second arch was closed.

3. We finally come to the case where the diagonal rib consists of a single arch of brick; there is an example of this simple solution in a hall of the Palace of the Cæsars (Plate VII., Fig. 4), whose ruins, isolated on a terrace of the Palatine, dominate the valley of the Great Circus. Each of the diagonal ribs (Fig. 46) consists of a single row of bricks in which are placed, from point to point, large square tiles whose shape is modified by a summary clipping. These projected from both sides of the arch and formed as it were headers which established a strong bond between the brick centre and the rubble.

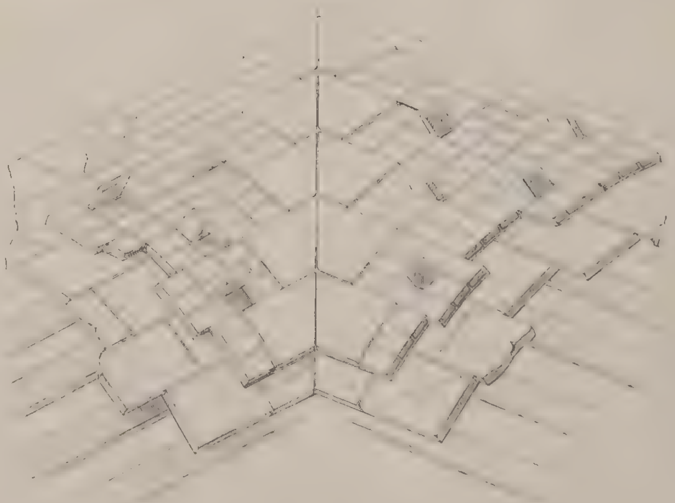


Fig. 45.

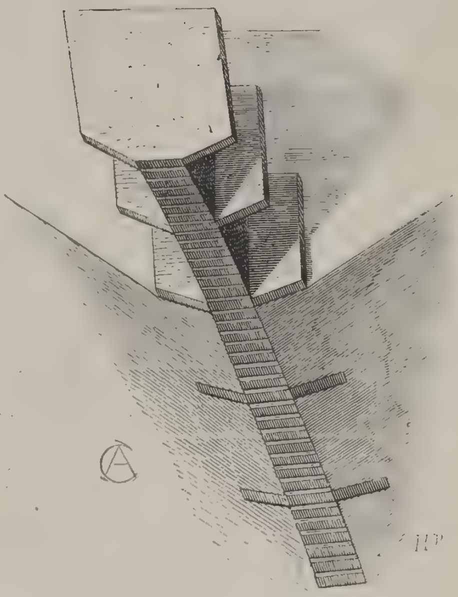


Fig. 46.

We have come to the elementary form of armatures in groined vaults; to complete the picture of the transformations which this system has undergone during the centuries which precede us, it would be necessary, passing beyond the limits of Roman art, to trace across the Middle Ages the forms of the intersecting vaults built from the eleventh to the sixteenth century in the western countries of Europe. We would find in the diagonal ribs and the salient transverse arches of the vaults of those times the equivalent of the Roman skeleton; but there the arches have an additional function. The active life of the armatures in the Roman vaults was limited to the time when the rubble, not yet set, needed auxiliary support; once it had become hard the armature was confounded with it and had no more importance than the stability of the structure, while the Gothic armature, having the same utility during the time of construction, kept a distinct *rôle* even after the centring was removed. It carried the entire weight of the panels of stone which filled the spaces between the ribs, and through it the weight was transformed to a system of thrusts that were taken up by the weight of the abutments, or by the counter-thrust of the flying buttresses. The conditions of equilibrium were entirely different in the two cases, and in order to show analogies of any value we must confine ourselves to comparisons during the period of construction. Then, at least, the resemblance is perfect, and the Gothic vaults show under a new aspect all the essential characteristics of the groined vaults erected during the Roman Empire. But it would be to go beyond our programme to follow out the differences and analogies. We have shown the principal variations which were given to the armatures in groined vaults, and we will show in the following paragraphs how the same principles of construction were extended to vaults on circular plans, that is, to cupolas or domes and vaults of a quarter of a sphere.

CIRCULAR VAULTS.

The vaults which bear the least on their centring are evidently domes; each horizontal section, because of its circular form, tends to sustain itself; and it would seem that a dome with a perfectly circular plan would have less need of an armature than of a mould to give it the required form. More than one ancient dome was indeed built with on other support than that afforded by its wooden centring, as, for example, the vault of the circular monument raised at the gate of Rome n honor of the mother of Constantine.

But the resistance to deformation resulting from the curvature of the surface decreased as the radius increased, and for domes like that of the Pantheon, where the curvature is almost imperceptible, the stability resulting from it may be said to be almost illusory. Even when they built on a smaller scale, the Romans seem to have feared the tendency of the masses to bear too heavily on their centres, and when the span reached a length of score of metres they considered armatures of brick useful in affording a necessary reinforcement to the temporary centring. In order to so strengthen the centring they sometimes attempted to revet the entire surface with a continuous network of brick, analagous to that shown in Plate I. But this envelope was hard to adapt to a spherical surface of a sphere. In order to do so it was necessary to place the lines of brick along the meridians of the vault, so that the meshes constantly varied in form and slowly and continuously diminished in size, — a condition which evidently would limit the application of this system. Hence circular vaults in which it is found are extremely rare; perhaps the most remarkable is that of the edifice called the "Torre de' Schiavi," at the left of the road leading from Rome to Préneste.

The method to follow in order to avoid the difficulties arising from the diminution of the meshes was to replace the continuous network by a system of isolated ribs dividing the surface of the vault into a series of segments.

On Plate X. is shown an application of this system. It is a vault from the ancient baths which stood behind the Pantheon at Rome. I have shown the armature only near the springing, for the upper parts seemed to me to be too vaguely indicated to allow of any attempt at restoration. Did the ribs of brick end suddenly by butting into a ring similar to that about the eye of the Pantheon (Fig. 49)? or did they cross like the groining ribs of intersecting vaults? The ruins give no reply; a street has been cut through the centre of the vault, and the part which still remains is, at the most, not more than the fragment shown in the drawing. The *débris*, however, has several claims to the greatest interest. If it comes, as is believed, from the Baths of Agrippa, its date is to be carried back to a time when Vitruvius alludes to baked clay as being among the usual building materials, and it is to be regarded as one of the oldest instances in the history of the art of building of the use of armatures of brick for vaults; and this supposition is certainly not contradicted by the aspect of the ruins. Everywhere the greatest care in the use of the materials is manifest, everywhere may be observed the minutest attention to the smallest details. Such characteristics would agree with a careful application of a new method; practice soon teaches builders to spare themselves pains, but here the workmanship is as good as the arrangement is well chosen, and though lighter armatures may be found in vaults of more recent date, it is needless to seek elsewhere for construction so correct or so irreproachable in regularity of form.

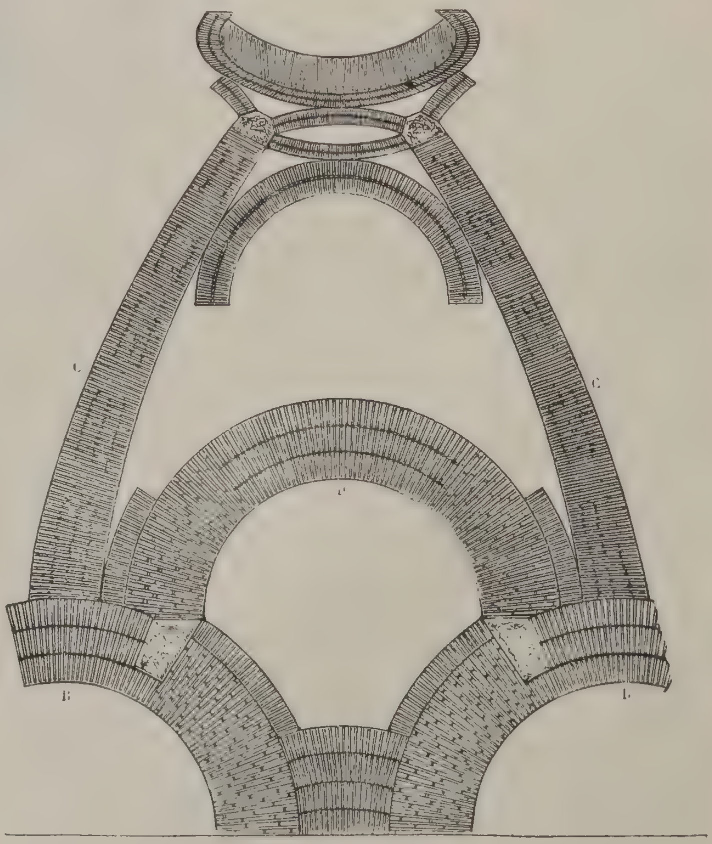


Fig. 49.

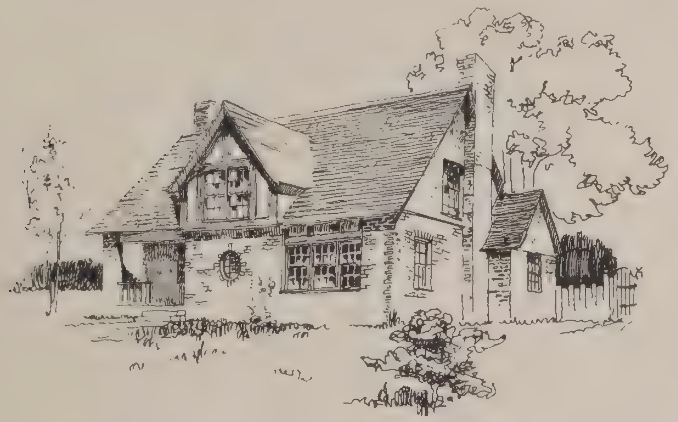
(*To be continued.*)

ON THE USE OF BRICK IN DOMESTIC ARCHITECTURE.

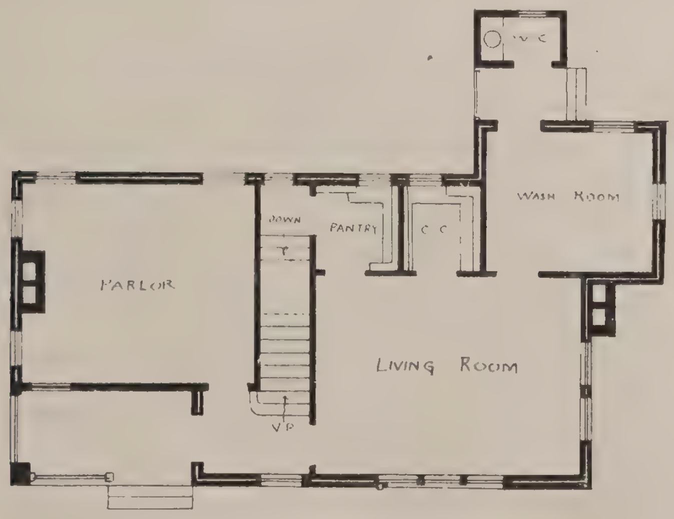
I.

WORKMEN'S COTTAGES.

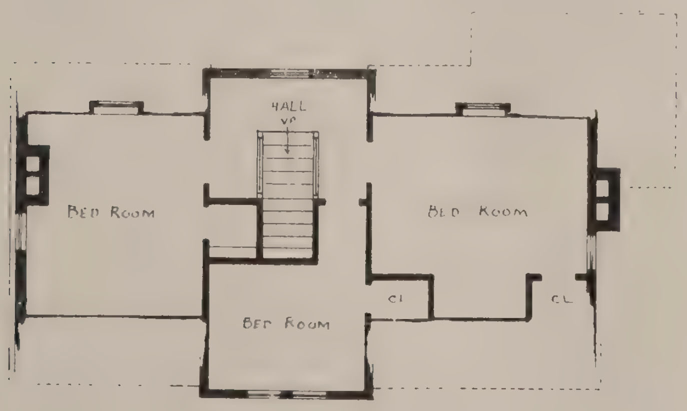
TO the traveller first visiting England there is, perhaps, no single phenomenon which surprises him more than the utter difference between English methods of building and those with which he has been familiar in America. This difference is not merely one which shows itself in works of engineering and heavy building, but it is equally obvious and even more surprising in the humblest grades of work, and in no place is it more startling than in the domain of house building, and that of the most modest kind.



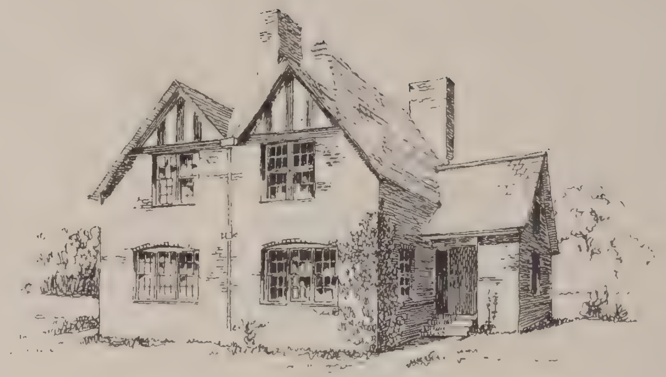
In this country we are so familiar with the acres of shabby, flimsy, unkempt, wooden shanties that do duty as dwellings in the lower-class sections of our villages, and with the hundreds of acres of equally flimsy and incomparably more shocking and offensive monstrosities that make up the better part of the residence portions of towns, that we never stop to think that really our wooden construction in this country from 1750 on is just as bad, just as illogical, just as stupidly inartistic as it can possibly be, and that for a century and a half we have been using a building material without the most rudimentary suspicion of its logical treatment or its great possibilities.



FIRST FLOOR PLAN

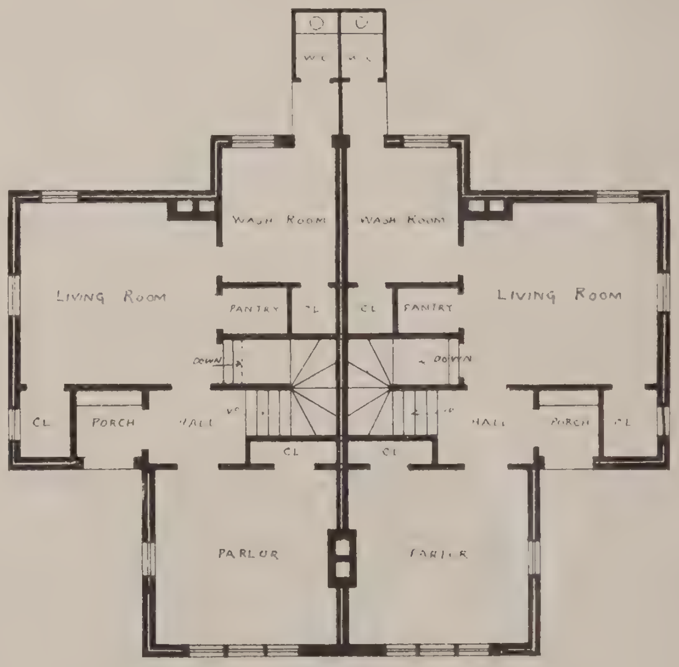


SECOND FLOOR PLAN

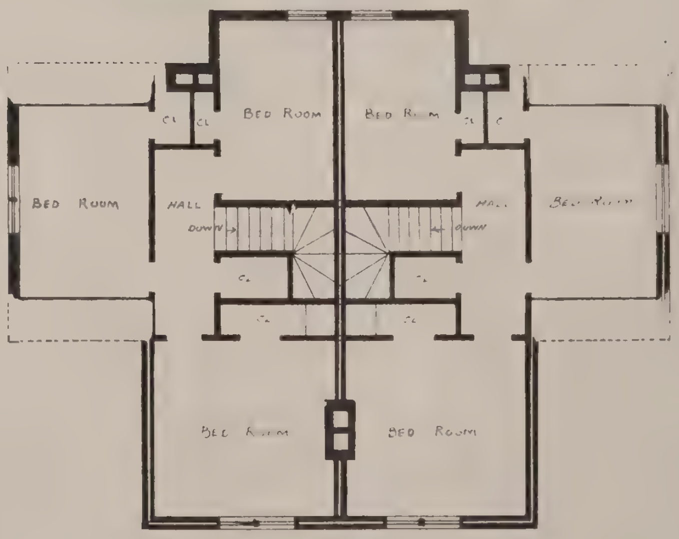


DOUBLE COTTAGE.

If it were otherwise, if we were surrounded by wooden construction like that of Warwickshire, Switzerland, Bavaria, or Japan, the shock might not be so great in passing from one of our rattletrap



FIRST FLOOR PLAN



SECOND FLOOR PLAN

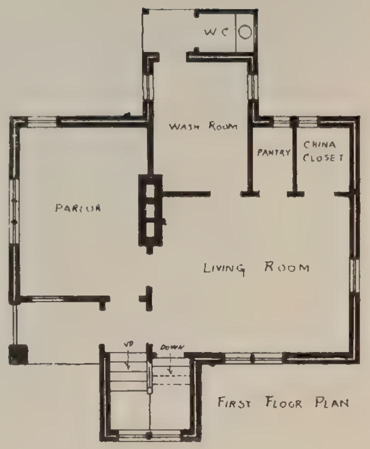
villages to the solidly built towns of England; but blighted as architecture has been by the ignorant misuse of a misunderstood material, perverted as our tastes have become through contemplation of imbecile wooden construction, the sudden discovery that mill towns and workmen's cottages need not be *quite* so dismally hideous and shabby as with us is apt to be something of a shock.

Outside the fire limits of cities the material now invariably used in the United States for the construction of the great majority of dwellings is wood. As a result we have an environment of æsthetic horror for those who live within the influence of Queen Anne, Colonial, and (save the mark) Romanesque cottages; we have flimsy, fire-trap barracks in the low-class quarters; and we have shabbiness, contagion, discomfort, and conflagration. And yet people uphold wooden construction because it is cheap, entirely forgetting that our national fashion of counting first cost only is quite as unpractical in this particular instance as in most others.

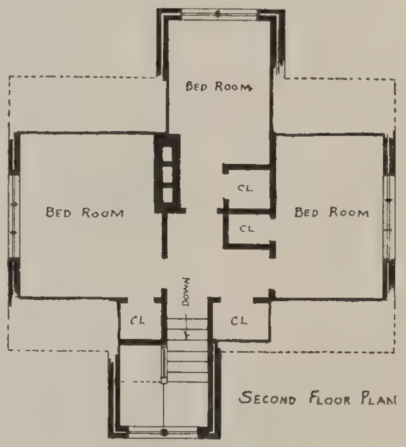
In England the matter is looked at in a more reasonable way, and as a result you find there, in the length and breadth of the country, hardly enough wooden houses to make up an ordinary American village. Every farmhouse, every workman's cottage, every barn almost, is built either of brick, stone, or half-timber work. It is unnecessary to mention the advantages thus gained; they are innumerable. Among all those which have a practical bearing on cost, sanitation, durability, protection against fire, etc., is one which is hardly considered, and that is the moral effect on the occupants. For my own part, I can't see how any man could live in an ordinary wooden factory block or a Queen Anne or Colonial cottage without being vulgarized, cheapened mentally, made uneasy, discontented, and miserable; while, on the other hand, a solid brick cottage, gathering dignified age day by day without losing anything of its stability, cannot help exerting an influence towards conservatism, permanence, self-respect, and dignity on its occupant. This may seem fanciful, but I believe it is based on reason. For an actual fact I know thousands of houses so "cheap and nasty" that I could imagine any crime, were it sufficiently sordid, being committed in any one of them, and through its direct and malign influence. Houses have more mental and spiritual effect on their tenants than we are willing to acknowledge.

But whether this be admitted or not, it cannot be denied that as between wood and brick as materials for domestic architecture, the latter has every advantage over the rival that now occupies the entire territory. Wood is but little cheaper than brick, even at first cost. By building a ten-inch wall of common red brick, two courses of brick with a two-inch air space, and by plastering directly on the inside brick, a wall is obtained which is stable, dry, warm, fireproof, and absolutely sanitary, while it costs but little more than the ordinary flimsy wall of clapboards, sheathing paper, boards, studs, back plastering, lath and plaster, the delight of cheap builders and also of rats, fire, germs, and decay.

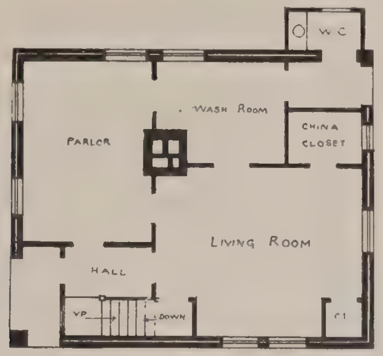
And if the first cost of honest and healthy construction is only a little more than that of cheap woodwork, the running cost is much less. Paint is an artistic horror, and expensive as well. It can only be used in the fashion now in vogue, among an artistically barbarous people, and a wooden house must be painted every few years in order to keep it in repair and — according to accepted ideas — in a condition of attractiveness. A brick wall, if built of common brick, is always good, and in a little time it becomes beautiful. It will last pretty nearly forever, while it is far warmer, far more healthy, than almost any other wall.



Why then is it not used? Well, first, because its cheapness is not appreciated; and second, for the reason that the mental temper of the time does not demand or even consider permanence and honesty in the construction of ordinary dwellings. The cheap builder cuts construction down to the very limit where his studs and joists and boards will hold together until the house is sold, putting what little money he spends into what he fondly holds to be ornamentation, viz., paint, stained glass, and *papier-maché*. Consequently we find in "progressive" towns whole districts made up of flashy and tawdry horrors doomed to certain and speedy shabbiness, if before the expiration of the few years necessary to bring this result the houses themselves have not collapsed into rubbish heaps. If "cheap clothes make a cheap man," very certainly cheap houses make a cheap people, and it would do no harm for us to look to it that we avert, if it is not already too late, this undeniable danger.

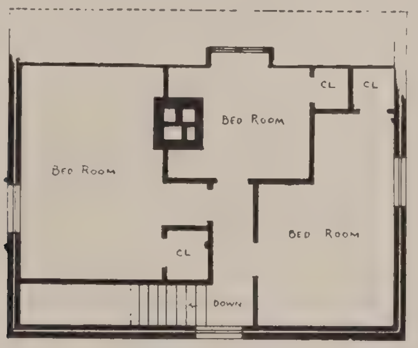


Arguments of this nature and towards this end will of course have absolutely no effect whatever in obtaining any reformation in domestic architecture; it will be necessary to show that a house may be built very largely of brick at a cost which will be but little greater than that of good wood construction. The plans and sketches which accompany this article are intended to show this. They deal with the simplest form of dwelling, a five-room, workman's cottage, to be built in the country or in villages which have no system of sewerage. In each case the accommodations are the same, viz., a kitchen or living-room, a parlor, pantry, china closet, and wash-room, on the first floor, and three bedrooms above. The cellar is under only a portion of each house, and there is no furnace. The walls are built of common red brick laid in white mortar, and are ten inches thick, including a two-inch air space. Inside, the plaster is placed directly on the brick. The finished woodwork is cypress or Washington cedar, finished natural with two coats of shellac; it is perfectly plain, without mouldings, even in the doors; the living-room and halls have rift hard-pine floors.



First Floor Plan

It is easy enough to imagine the ordinary wooden house that would be built for the same amount of money that one of these cottages would cost. It would probably have clapboards on the first story, shingles on the second. If it were Queen Anne, it would have turned balusters and columns all over it, with a fluted or jig-sawed panel perhaps. Its roof would be "picturesquely irregular," with little curved dormers in it. The glass in the windows would be cut up into fantastic shapes, and that in the panel of the front door would be violently colored. If it were "Colonial," it would have *papier-maché* festoons stuck on, and be painted yellow and white; otherwise its colors would be innumerable and chaotic. Rank, ridiculous cheapness would stick out all over it, and it would sell netting the builder twenty-five per cent on his investment. Whether such a house as one of those indicated in the accompanying sketches would sell or not must remain to be proved. At all events, it would be an honest house, while the others could pass only as shanties.

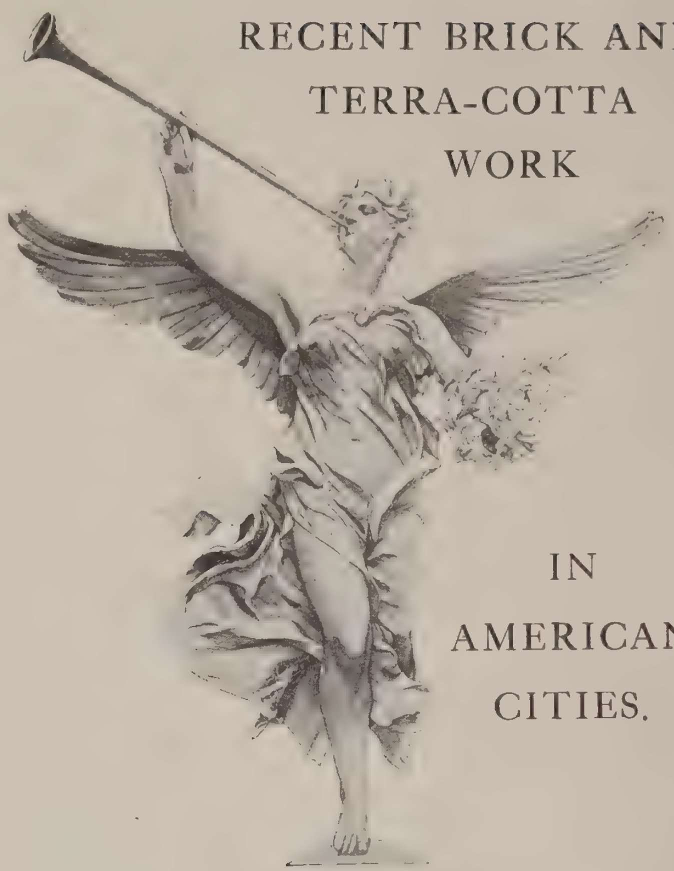


Second Floor Plan

Its first cost would be a little more than that of wood; this cannot be denied. But the extra cost would not exceed $150 on each house. A speculative builder would never think of squandering this sum on a house which would sell just as well if it were built of wood and "tastefully" painted; but it is hard to believe that an average workman of good sense, building a house for himself, would, if he knew the facts in the case, hesitate for a moment over the two courses before him. If men of this kind can be induced to see the immense advantages of a brick house over a wooden shanty, not only in point of health, comfort, and durability, but actually in the matter of first cost, we may yet see some good honest building in the country, where now we have only too much of shameful and shabby cheapness.

Ralph Adams Cram.

RECENT BRICK AND TERRA-COTTA WORK IN AMERICAN CITIES.



TERRA-COTTA FIGURE IN HIGH RELIEF.
Executed by the American Terra-Cotta and Ceramic Co.

THE WORTHINGTON BUILDING, BOSTON.

Fehmer & Page, Architects.

THIS new building, which is to occupy the site of the old Traveller Building, 31 State Street, corner of Congress Street, covers an area of about 2,600 feet; is to be a modern office building in all respects, and absolutely fireproof throughout.

The building is designed in the style of the Italian Renaissance. The first two stories, belt courses, window trims, and main cornice are of Indiana limestone, of a light gray color; the remainder of the building is of brick and terra-cotta, made by The New York Architectural Terra-Cotta Company to match the stone work, so that the building will be uniform in color for its entire height.

The treatment of the State and Congress Streets fronts is carried around the building. The stone work around entrances and window openings will be elaborately carved, and handsome grille work of iron or bronze will be introduced in toplights and openings over same.

The steel frame has been designed to insure an absolutely substantial structure, and so constructed with steel-plate girders and uprights as to form a continuous wall of steel the entire height of the building back of the masonry.

The most careful study has been given to designing this frame to guard against wind-pressure, or from any annoyance caused by vibration.

The steel frame throughout the building will be protected on the exterior and interior by masonry.

The principal entrance is in the centre of the building, with hallways extending through to the entrance on Congress Square.

At the left, as one enters from Congress Street, is the entrance to the basement, over which, leading from the main hall, is the staircase to the second story. At the opposite end are two elevators running from basement to tenth floor.

The basement, first, and second stories are planned with the hallways occupying the centre of the building, opening off from which, through double doors, are the two large banking offices, one on each side of the hall.

In addition to this entrance from the main hall, the banking office on State Street, first story, has a private street entrance, which forms one of the features of the State Street façade.

The finish in the first and second story offices will be of mahogany, with mosaic floors and handsomely panelled ornamented ceilings.

The upper stories are planned with the elevators and staircase occupying the central portion of building on Congress Square side, with hallways extending through the centre of building and offices opening off on each side. The partitions are brick and terra-cotta blocking throughout. (See Plates 9, 10, and 11.)

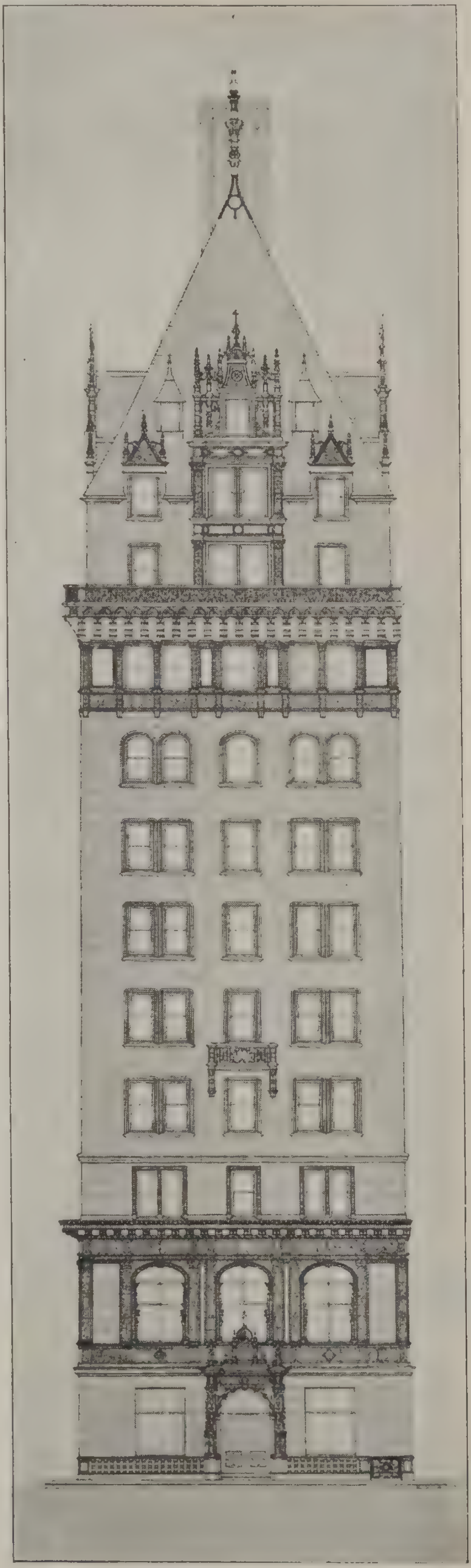
MR. ROBERT H. FOEDERER'S RESIDENCE, PHILADELPHIA.

HAZELHURST & HUCKEL, ARCHITECTS.

THIS is the latest of the many elegant residenes built on North Broad Street. It is constructed of buff Roman-size brick and white terra-cotta, with first story of Indiana limestone. The columns to front entrance and loggia above third story, also spandrel over the main door, are Pabanazza marble. The terra-cotta work was made by Stephens, Armstrong & Conkling of Philadelphia, and the brick by the Eastern Hydraulic-Press Brick Co.

The color tone of the building is exceedingly pleasing, and, with the details and modelling, has been carried out with great care and fidelity, and is another example of the use in combination of brick and terra-cotta in Philadelphia buildings of recent date.

For elevations and plans see Plates 12, 13 and 14.



THE HARRISON OFFICE BUILDING, PHILADELPHIA.
COPE & STEWARDSON, ARCHITECTS.

HARRISON OFFICE BUILDING, PHILADELPHIA.

A TYPICAL terra-cotta building. Terra-cotta from first to twelfth story, outside and inside, partitions, beam coverings, floors, flues, and stack, all of this material, which is so suddenly springing anew into use as a first-class building material. This building shows, more than any other in this city, the possibilities of terra-cotta as taking the place of stone in large commercial buildings, and may be considered as marking a new era in terra-cotta construction.

Beginning at the base, we have several courses of Indiana limestone to the tops of the sills of the first-story windows, where the terra-cotta commences. This stone wall is backed with bricks, and is the only instance of the use of bricks in the building. From this point to the top the walls are entirely of terra-cotta, save of course the steel framing. The first story shows massive blocks of terra-cotta, some being as large as twenty-one inches by forty inches on the face, and thirty-four inches deep in the wall. The blocks will be built up as usual in the heretofore smaller work, having a sufficient number of horizontal and vertical partitions or ribs to prevent any undue distortion of the blocks during the process of burning. They will be closed entirely on all sides, except the necessary small openings at the ends, and will be keyed on the top, bottom, and sides. The cornice blocks, bonding courses, and corbels will extend entirely through the walls and be scored on the inside to receive the plastering; other blocks will extend about half-way through the walls, forming a bond with the interior backing, which is of the same material made somewhat lighter in section and weight and likewise scored for the plastering.

The face of the walls will be finished similar to fine tooling as used in stone; and the first, second, third, ninth, and tenth stories exhibit a richness of detail seldom attempted in buildings which are purely utilitarian; the second story, the two principal entrances, and the large dormer-windows being especially rich. The ornamentation of the second story is taken from one of the façades of the Hotel Bourgtheroulde, and the architects have very successfully designed the cornice over this story in perfect harmony and proportion to the ornament under it, as well as to the entire mass of the building.

The building presents several unique features. In the first place we think it sets forth the first instance where a stack for the fireplaces and boilers is constructed of a steel frame with curtain walls. It is rigidly connected to the frame of the building, and extends in height a distance of about one hundred and fifty feet from the first floor. It also shows a treatment of the party wall which is very commendable, as it is kept entirely clear of the party line, and can never be disturbed by the erection of any neighboring building. It is built of the same material as the fronts, and the upper stories are treated in the same richly ornamental manner. Thus it will be seen that the view of the building will be beautiful from all points of sight, and will not be marred by the usual unsightly party wall.

Another step well taken, we think, is the determination of the architects, Messrs. Cope & Stewardson, to prevent if possible in this building the top-heavy and hollow appearance of the walls, so perceptible in many of the high buildings recently built. They purpose to do this by building the walls with a regularly defined entasis, the same as is usual in high columns, and strengthening the effect thus produced by forward projections in the first and second stories, and by setting back or receding the walls in the extreme upper stories. In this manner the top of the wall is receded so that at the eaves of the roof the face of the wall is seventeen inches back of the face at the first story; and the perspective drawings, carefully made with a view of determining the exact effect of this treatment, show an improvement in the appearance of the whole which is entirely satisfactory. The dormer-windows and face of the stack, which extend above the eaves, are made to continue the entasis and also slant backward correspondingly, instead of being perfectly vertical.

The manner of the construction of the steel frame, which allows of the treatment above referred to, is very interesting, and in some instances unique, but cannot be dwelt upon here.

The style of the building is the French Renaissance of the period of Francis I., and it will be seen that the style has been strictly adhered to in all the details, this being true especially of the ornament, which is very rich, discreetly used, and highly appropriate.

The Perth Amboy Terra-Cotta Company, who have taken the contract for the terra-cotta required for the work, furnished about a dozen large blocks of different kinds and shades of terra-cotta, made up in the manner described, for preliminary testing, etc. They were built up, plastered, and weighed; and it was found that the plaster adhered firmly to the material, and that those blocks made with a thickness of shell and webs of one inch weighed fifty-five pounds per cubic foot, while those having shell and webs of one and one half inches weighed seventy pounds; this weight, when compared to the weight of stone or brick, gives a fair idea of the saving in total weight effected by the use of this method.

The floors are of the usual hollow arches, end construction, with a topping of cement concrete for floors, and a wood strip around the edge of each room for carpets if desired. There is no window trim, except a wood sill; and this sill, the doors, and baseboards sum up all the wood in the building. It is therefore strictly fireproof throughout.

SIBLEY MEMORIAL HOSPITAL, WASHINGTON.

Clarence L. Harding, Architect.

ILLUSTRATIONS of elevation and floor plans of this hospital may be found in Plates 15 and 16. The hospital was a gift to the city of Washington from Mr. Wm. J. Sibley, as a memorial to his wife. It is considered a very good example of what can be done with a comparatively small amount of money, the entire cost not exceeding $10,000. The front is of brick and terra-cotta. The vestibule, baths, lavatories, operating and emergency rooms have floors of unglazed, vitrified, encaustic tiles. The sinks, bath-tubs, and slop-sinks are porcelain, and the plumbing is a fine feature throughout. Each ward accommodates ten beds, and the whole building is complete in all of its appointments.

MORE BRICK BUILDINGS.

A FEW more new buildings were started in Boston this January than last, the gain being in brick structures, which numbered thirty-seven against thirty in 1894. Permits for frame buildings decreased two, the number being seventy. Considering the large increase during the latter part of 1894 over 1893, this showing is favorable.

Compared with January, 1893, the gain in brick construction is remarkable, the number that month being only eight. The frame buildings this year were fourteen fewer, however.

BUFF BRICK IN NEW YORK.

BUILDERS and dealers in building material believe that the buff brick is to be a permanent and increasing conspicuous feature of New York architecture. Several considerable buildings of that material are now going up. The North Jersey fire clays, from which the buff brick is made, are seemingly inexhaustible, and the material can be brought to New York very cheaply. Some of the clays that lie near those used for these bricks are too valuable for ordinary building purposes, and are sent all over the country to be worked up for other uses. The crude clay is worth in some instances $100 a ton. If the buff brick can be reduced in price, its use will be greatly extended, because houses and office buildings of that material rent more easily than equally well-situated buildings of other materials. Luckily for house owners, the mere cost of front brick, whether red or buff, is not an important item in the construction of a considerable building, so that even a slight reduction in the price of buff brick would probably greatly extend the use of that material. — *New York Sun.*

THE STRENGTH OF OLD BRICKWORK.

AN interesting piece of information respecting the strength of old brickwork is the result of experiments carried out by Mr. A. G. Lyster, the assistant engineer to the Mersey Docks and Harbour Board. The brickwork in question was part of a wall of the Albert warehouses in Liverpool, and was built about fifty years ago of hand-made bricks laid in ground mortar made with lime from the Halkin Mountain, Flintshire. This lime is in a high degreee hydraulic, and makes mortar of exceptionally good quality. Having to demolish the wall, Mr. Lyster conceived the happy thought of leaving a piece of it in the form of a horizontal beam, having a twelve-foot span, and measuring about two feet square in section, seven courses in height of a two-foot wall. The ends of the beam were not cut free from the rest of the work. This beam was then loaded with all the weight that could conveniently be piled upon it in iron "kentledge," without appreciable deflection or other sign of weakness resulting. Two courses were then cut off, and the whole weight again put on, but without other result. The beam was further reduced by a course, leaving it four courses, or fourteen inches deep, and the ends were also cut free from the other work, the mortar beds of the twelve-inch bearings being left untouched. A centrally placed load of five tons, fifteen hundredweight was then gradually piled upon it, and was borne for several days without apparent effect upon the brickwork. Finally, the weight was increased to six tons, nine hundredweight, twenty-three pounds, which was sustained for thirty hours, when the beam collapsed during the night, and came down in pieces more like broken timber than anything else. Other tests were made with similarly astonishing results; but the above are sufficient to show what really first-rate brickwork in hydraulic lime will stand.— *British Clay Worker.*

J. W. Morrison, architect, has opened offices at 313 Jefferson Street, Jamestown, N. Y.

The firm of Brede & Zimmerman, architects, Detroit, Mich., dissolved partnership Feb. 1. Mr. H. A. Brede will continue the business.

Frank Horton Brown, architect, has removed his offices to White Plains, N. Y. The Port Chester office will be continued as a branch at which Mr. Brown will spend Wednesdays of each week.

The Van Rensselaer house, opposite Albany, N. Y., is believed to be the oldest inhabited house in the United States. The building was erected, it is said, in 1642, of bricks imported from — Holland. *The Southern Architect.*

The Architectural League of New York began their tenth annual exhibition of Architecture, Painting, and Sculpture in the galleries of the American Fine Arts Society Building, 215 West Fifty-seventh Street, on the 15th of February. The exhibition closes the 9th of March.

The Chicago Architectural Sketch Club seems to be a very much alive affair, as may be seen by the following programme: Monday evening, Jan. 21, Mr. Thomas Hastings's paper on planning was read and illustrated by stereopticon views; Monday evening, Feb. 4, a musicale by the members of the Marquette Club Minstrels; Monday evening, Feb. 11, a "Rip Snorter." (For particulars apply to Billy Gibbs, Bob Williamson, or Major Hoeppner, hosts.) On Monday evening, Feb. 18, Mr. F. G. Perkins read a paper entitled "The Comparative Merits of Steam and Hot Water Heating," this paper being the first of a series upon practical subjects.

OUR ILLUSTRATED ADVERTISEMENTS.

THE Hydraulic Press-Brick Company has chosen as the subject for this month's illustration in their advertisment (see page xvii),

THE CATHEDRAL AT ASSISI.

This company is the parent of the many hydraulic companies that exist in the several parts of the country, addresses of which are given in the advertisement, and the liberality it shows in the matter of expense in publishing these excellent examples of old brickwork is certainly commendable and very much appreciated.

THE COLONIAL CLUB,

Henry F. Kilburn, architect, one of the noteworthy buildings recently erected in New York, is chosen for illustration by the New York Architectural Terra-Cotta Co. (see page xvi). It is a pleasing example of the excellent effect that may be obtained by the use of the lighter shades of brick and terra-cotta in exterior work. We publish herewith three bits of detail executed by the New York Company who supplied the terra-cotta. The buff brick used in the façade was furnished by Sayre & Fisher Co.

Another faience medallion executed by Andre della Robbia is the fourth in the series of illustrations by the Atwood Faience Company (see page xv). Particular interest attaches itself to the work being done by this company (examples of which we shall publish in our later numbers), owing to the fact that a great deal of faience work is now being used in exterior work in Chicago.

NEW ADVERTISEMENTS.

WITH this number we begin the advertisements of Sayre & Fisher Co., of New York, manufacturers of fine pressed front and enamelled brick. (See page xiv.)

The Peerless Brick Company of Philadelphia, one of the oldest established front brick concerns in the country. (See page xiv.)

The Philadelphia Enameled Brick Works. (See page ii.)

The Northwestern Terra-Cotta Company of Chicago (see page v), who have executed some of the best designs in architectural terra-cotta that are to be found in this country.

And last, but not least, the Pioneer Fire-proof Construction Company of Chicago. (See page iv.)

NO doubt most of our readers will recall the announcement in our September number of the fact of the total loss by fire of the American Ceramic Terra-Cotta Company's works on the 20th of last September, also the statement that, with their characteristic energy, the company had commenced rebuilding at once. How rapidly this work of construction must have gone on may be imagined when it is stated that within three short months the present substantial, well-arranged buildings have been erected and equipped with all the latest and best improvements in machinery for turning out terra-cotta. Although such a catastrophe as that through which the company has recently passed is always a hard blow to immediate business, still it has some later benefits in the reconstruction of the works. As in this case, the company, profiting by their past experience, rearranged the entire general floor plan of their buildings with a view to the most expeditious location of each department for its particular work, and then equipped the same with such machinery as in their judgment was the best possible for the purpose, and which would yield the best results. We are told that in time alone (that great bugaboo to the terra-cotta manufacturer) the company have been enabled to save a quarter over that which they formally required to complete work, owing to the many advantages of their present arrangements, and this in addition to the fact of the work being better in quality than before. It would be hard to find a more interesting operation than to watch the evolution of the coarse gray clay into the graceful terra-cotta designs, with their beautiful colors and harmonious effects. That this particular branch of the terra-cotta industry is in its infancy all are ready to admit. What it shall mean to the building profession when it shall arrive at that state of incorporating into its structure all the beautiful color effects that are now promised, who dares to prophesy!

ANOTHER "BRICKBUILDER" COMPETITION.

WE are making arrangements to hold another competition, open to subscribers of THE BRICKBUILDER, for which suitable cash prizes will be offered. The subject will be "A City House," fireproof throughout, with a brick and terra-cotta front. The limit cost and details will be announced in the March number. As has been our custom, we shall publish the successful designs.

To clubs of five and ten or more draughtsmen, wishing to subscribe to THE BRICKBUILDER, we make a special rate. To one who will act as our agent in securing subscriptions, we will allow a liberal cash commission. Write for particulars.

TO DRAUGHTSMEN.

ANY draughtsman out of employment, who will send us his full address and answer the following questions: —

By whom were you last employed?
Can you furnish good recommendations from your last employer?
On what particular line of work have you been engaged?
What salary do you expect to receive?
Are you willing to go to another city?

may have his name placed in our Exchange Bureau, and will be notified of any parties desiring his services as a draughtsman.

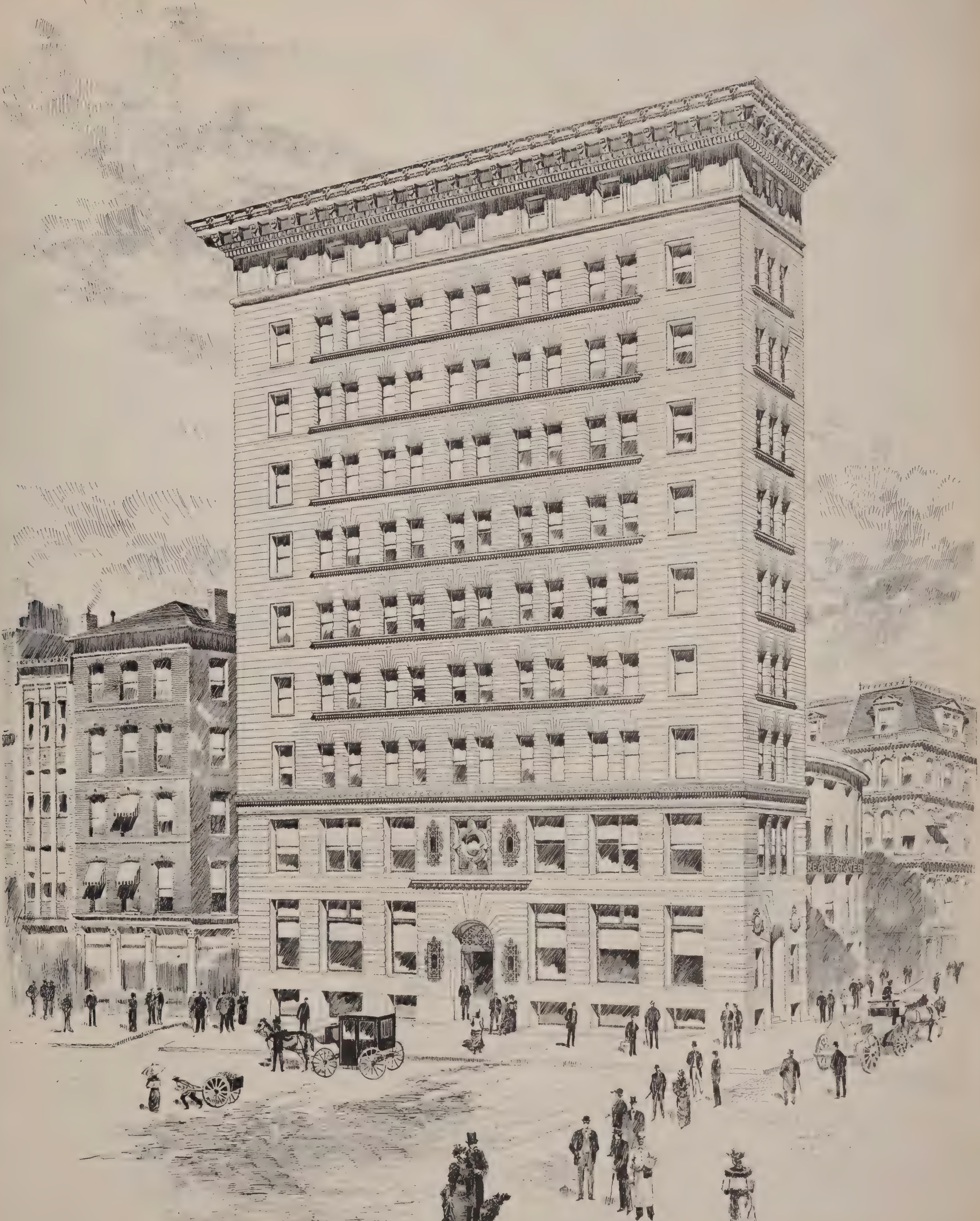
All such communications will be regarded as confidential, and no charge will be made.

Address, EXCHANGE BUREAU,
THE BRICKBUILDER PUBLISHING CO.

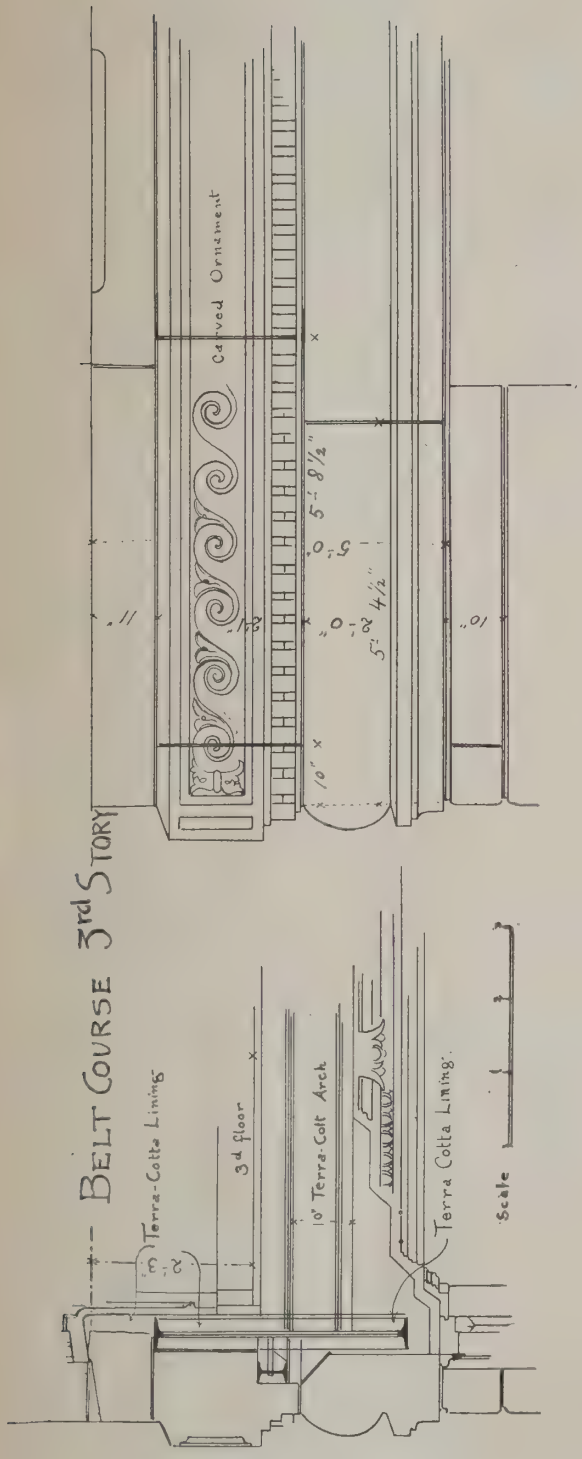
TO ARCHITECTS.

WE call your attention to the foregoing announcement, and upon your application would be pleased to put you in communication with any draughtsman whom we think would meet your requirements. All communications will be regarded as confidential, and no charge will be made.

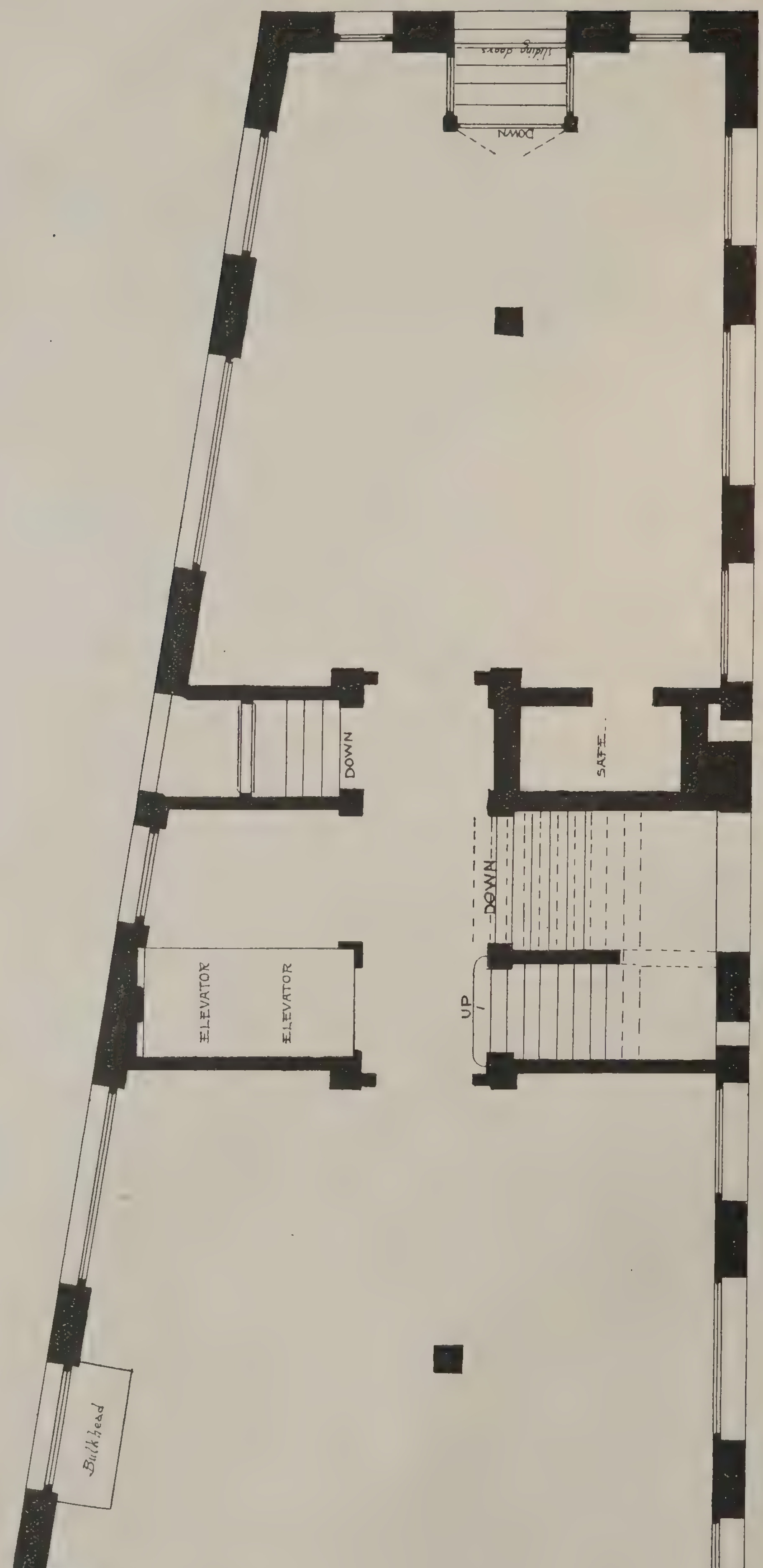
Address, EXCHANGE BUREAU,
THE BRICKBUILDER PUBLISHING CO.



WORTHINGTON BUILDING, STATE STREET, BOSTON.
Fehmer & Page, Architects, Boston.



BELT COURSE 3rd STORY



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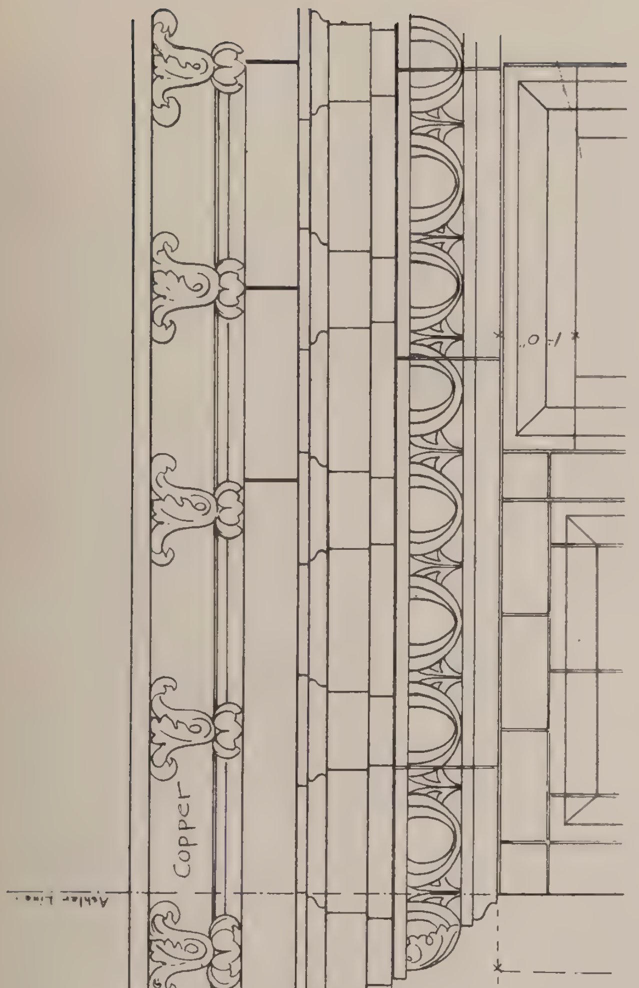
WORTHINGTON BUILDING

FIRST FLOOR PLAN

Scale 1/8 in = 1ft.

FEHMER & PAGE ARCHTS.



CORNICE

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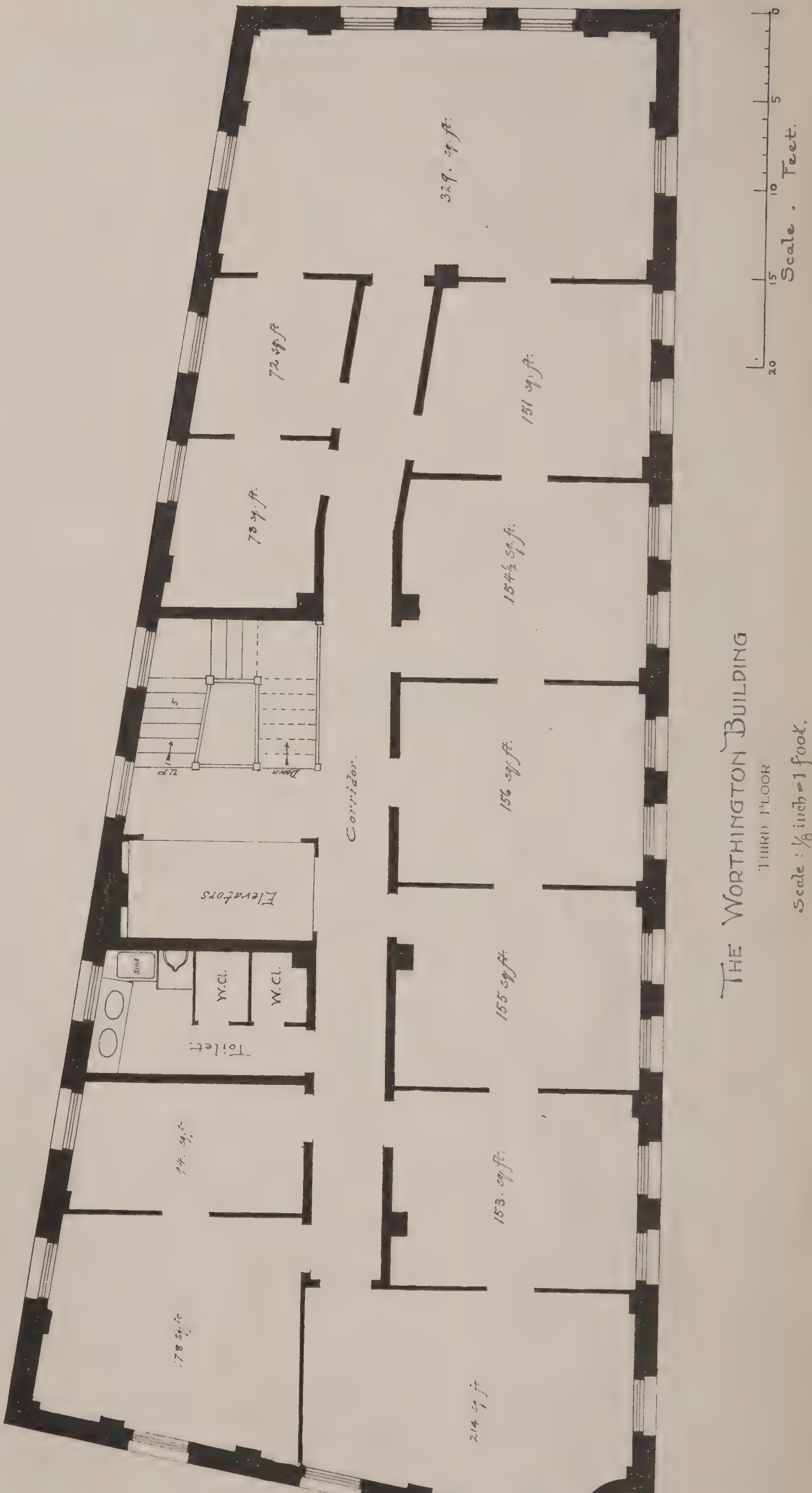
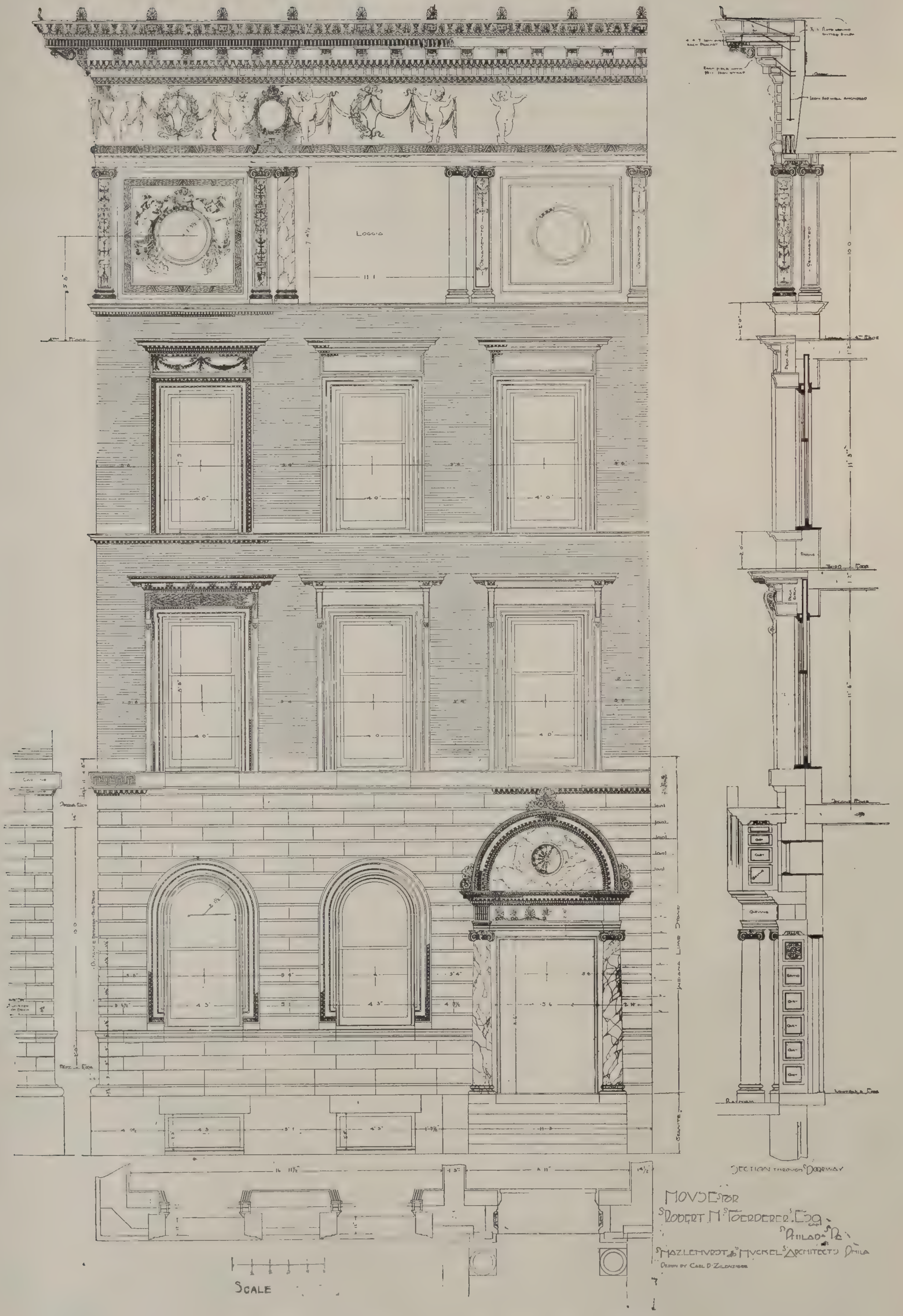


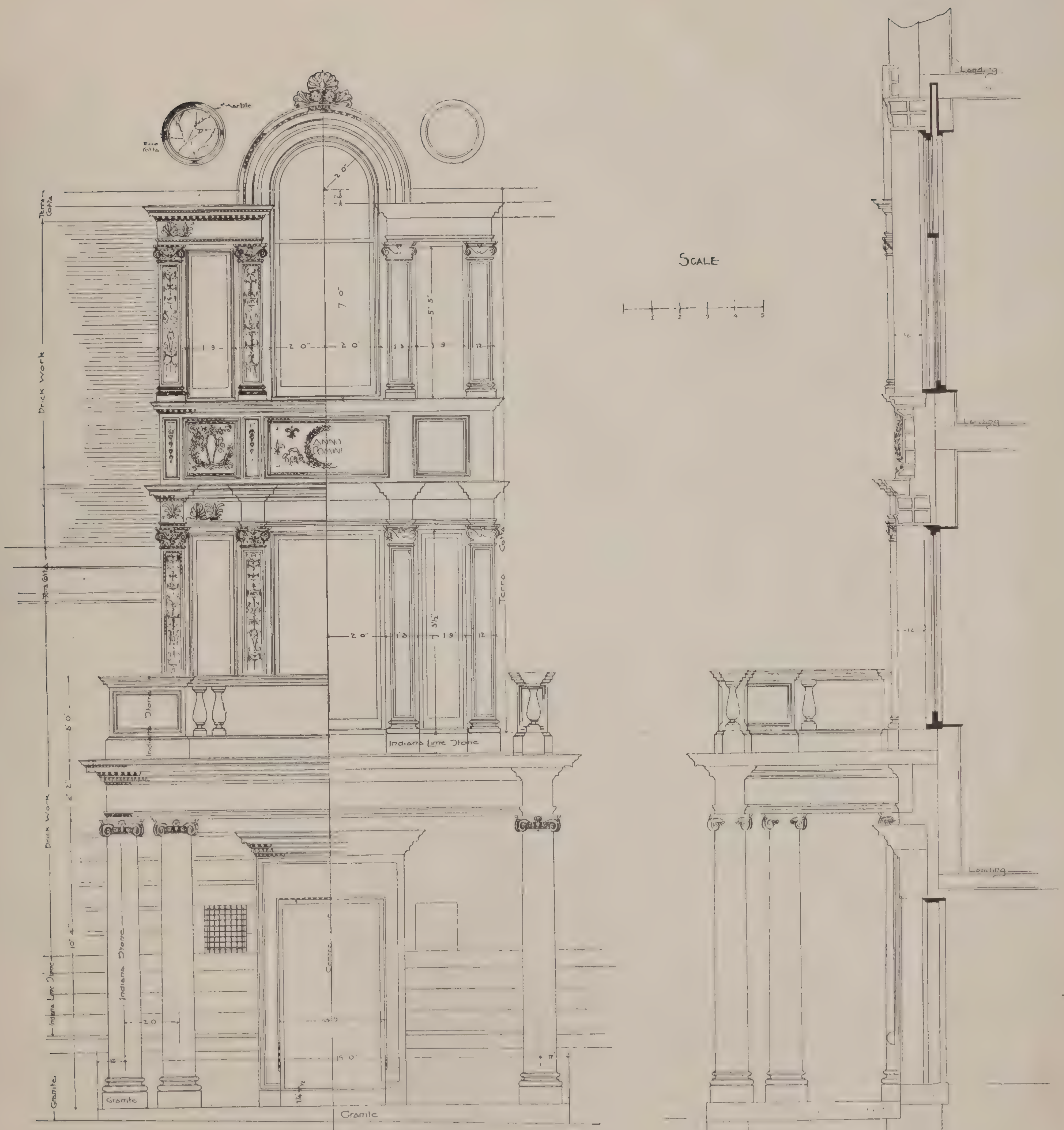
THE WORTHINGTON BUILDING

THIRD FLOOR

Scale: 1/8 inch = 1 foot.



RESIDENCE FOR ROBERT H. FOERDERER, PHILADELPHIA.
HAZELHURST & HUCKEL, ARCHITECTS.



RESIDENCE FOR ROBERT H. FOERDERER, PHILADELPHIA.
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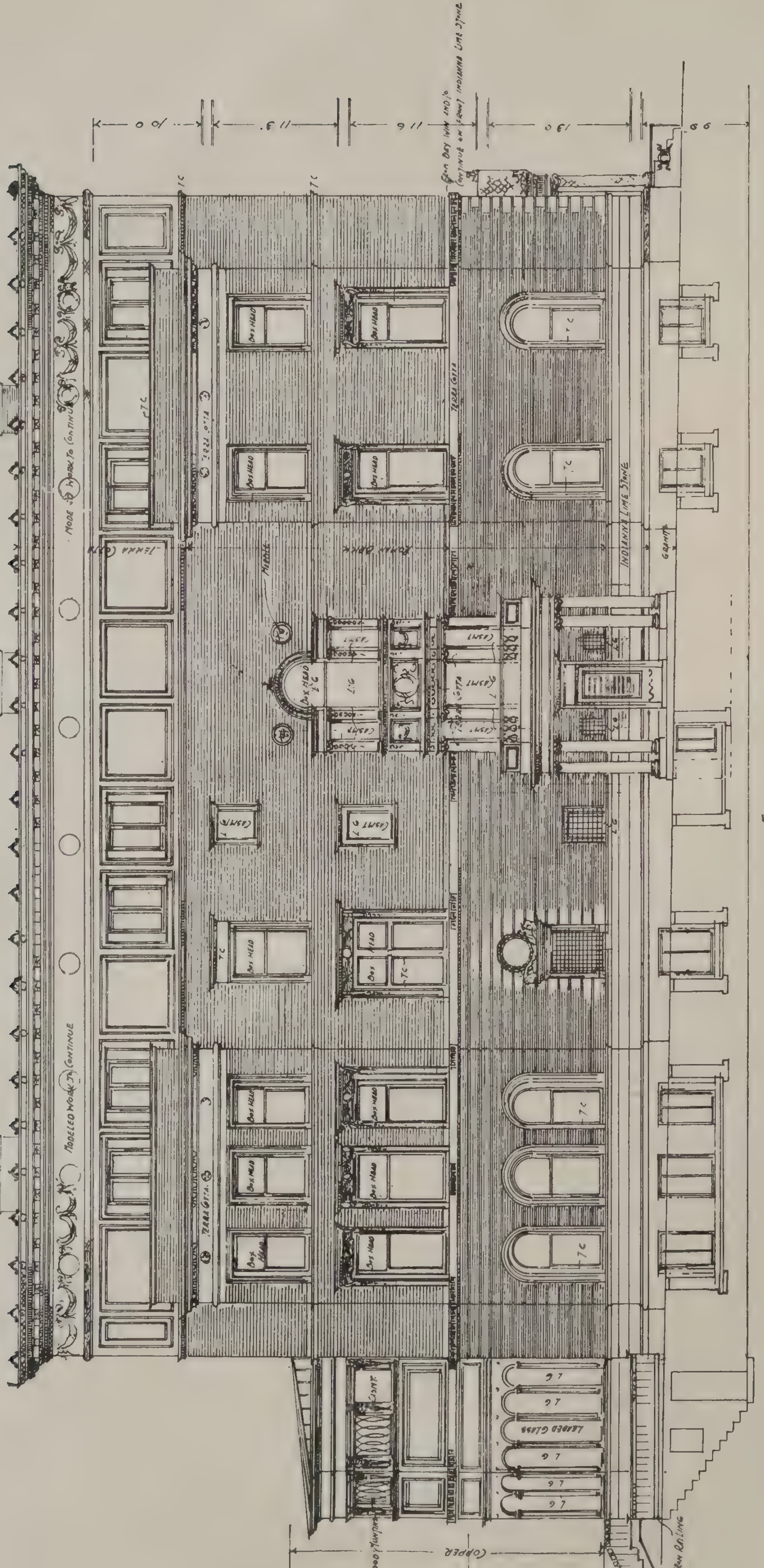
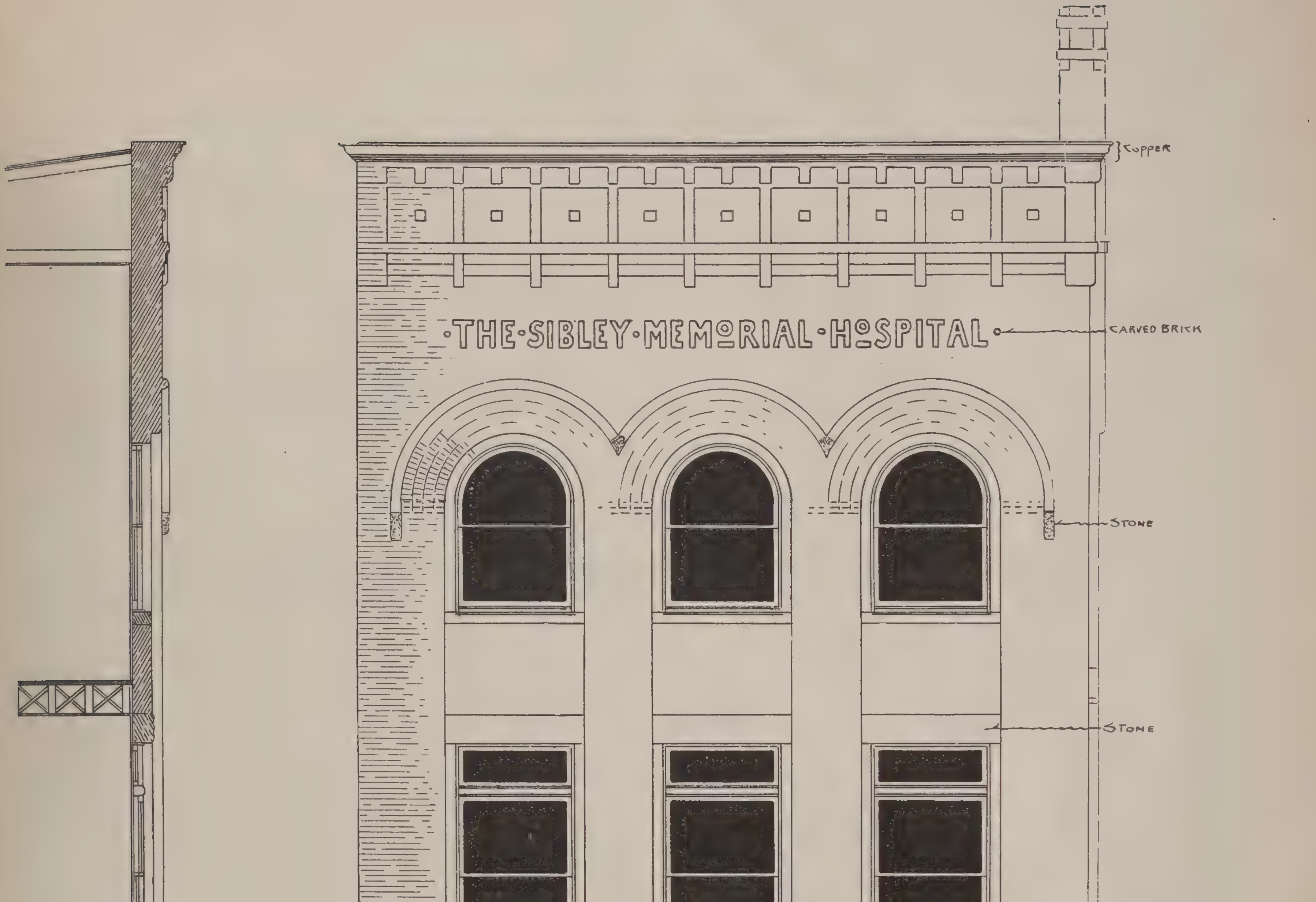
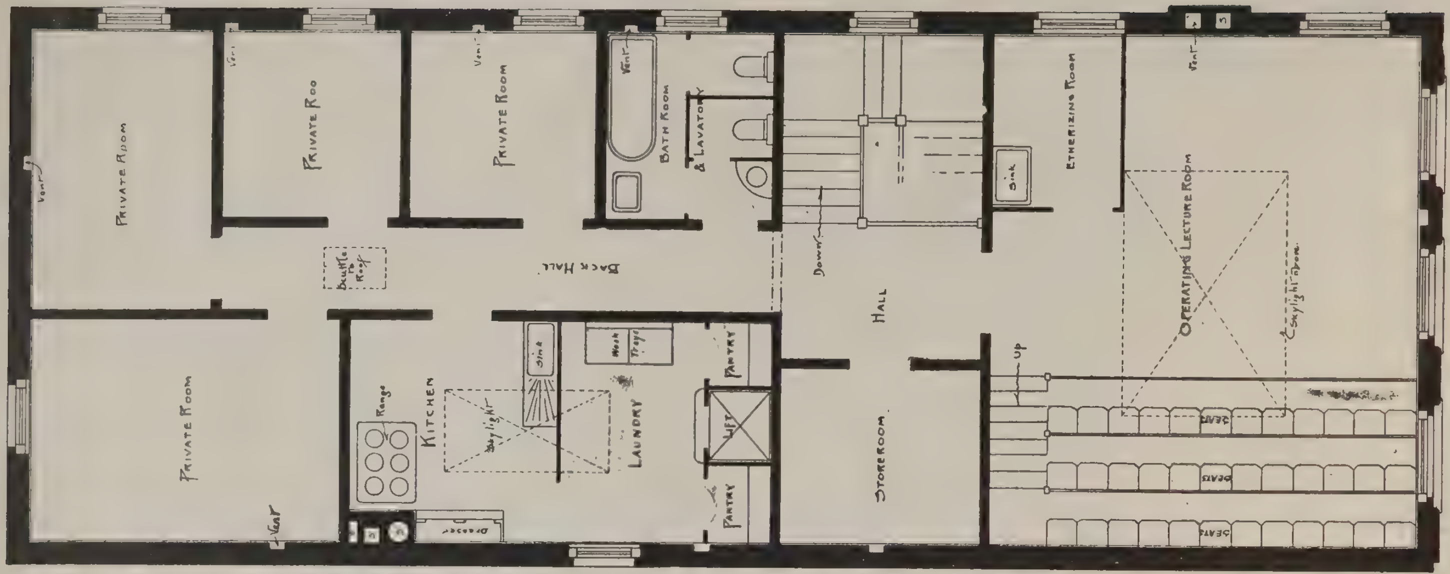


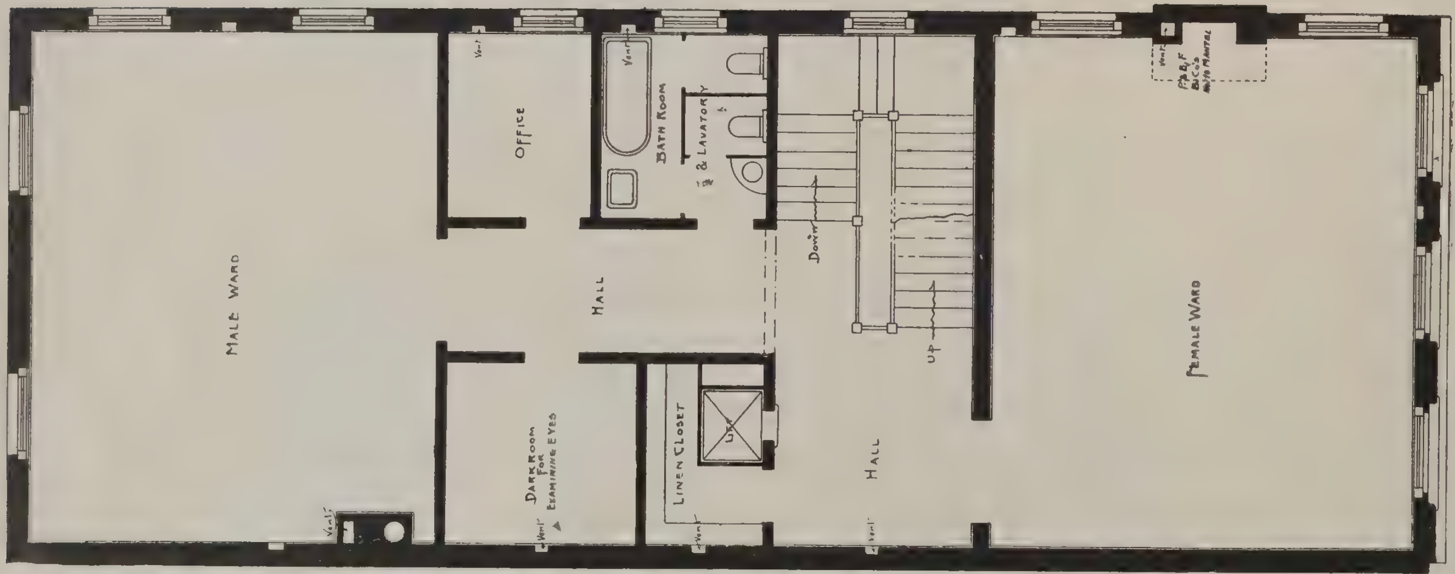
SIDE ELEVATION

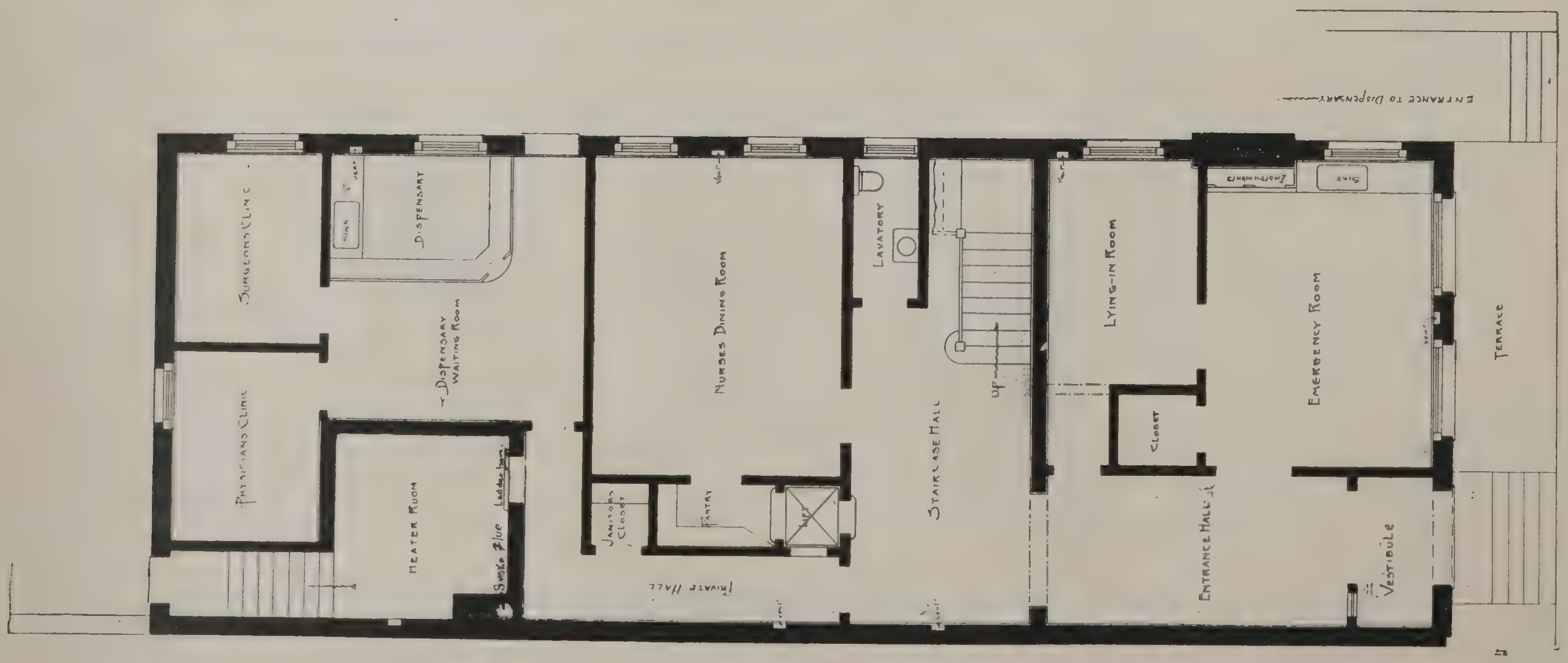
RESIDENCE FOR ROBERT H. FOERDERER, PHILADELPHIA.
HAZELHURST & HUCKEL, ARCHITECTS.



FRONT ELEVATION, THE SIBLEY MEMORIAL HOSPITAL, WASHINGTON.
Clarence L. Harding, Architect.







FLOOR PLANS, THE SIBLEY MEMORIAL HOSPITAL, WASHINGTON.
Clarence L. Harding, Architect.

THE BRICKBUILDER.

AN ILLUSTRATED MONTHLY DEVOTED TO THE ADVANCEMENT OF ARCHITECTURE IN MATERIALS OF CLAY.

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STEEL CONSTRUCTION AND BRICK MASONRY.

WITHIN the past few years a change has taken place in the methods of construction adopted for commercial buildings which is one of the most radical that the world has ever seen, involving not only a complete revision of the theory of construction, but also a reversal of the uses to which some of the materials have been previously put. This change has come as a result of the employment of what is known as the skeleton construction, a system in which the loads of the walls and the floors are all carried down to the ground through steel columns either isolated in the building or built into the thickness of the external walls. In this construction, when carried to its fullest development, masonry as a supporting member counts for absolutely nothing. Brick walls, as such, disappear, and are replaced by screens of brick or stone interposed between the tiers of beams and carried around the steel work, not to strengthen the supporting members, but simply to protect against fire and the elements. So that brick, which was once the fundamental material for building construction, has now simply a decorative or fireproofing function. Of course the vast majority of buildings are now and always will be built in the old method, with solid walls directly supporting the loads, but the increase in the use of the skeleton construction has been so extensive that those who are interested in the manufacture and use of brick as a building material may well ask what has been the influence of the steel construction upon the humbler material.

ACCORDING to the building laws existing in most cities, a brick wall to be carried to the height of the walls in the Manhattan Life Building, New York, would have to be six feet thick. As a matter of fact, the walls of this building in connection with the steel construction are from twelve to sixteen inches thick; so that at first thought it would seem that the skeleton construction has greatly reduced the quantity of brick which would be used in connection with building operations. This is not the case, however. No architect or engineer would dare to build a structure three hundred feet high with walls less than ten feet thick, and consequently such buildings would never have been built except for the skeleton construction; and although the walls may be a great deal thinner than would have been used with the older systems, the results, on account of the extreme heights possible with skeleton construction, show a vastly increased quantity of brick actually employed in building operations. Nor is this all. Brick, on account of the ease with which it is handled and set and the facility with which it can be built into and about the forms of beams and columns, is generally preferred to any other material for both interior and exterior masonry walls of a tall building. Stone is attached with difficulty to the skeleton construction, and is not structurally as satisfactory. Consequently brick and terra-cotta have acted to a very marked degree to drive out stone from tall building construction, so that the quantity which is now used, not only of common brick but of face brick as well, has been greatly increased by the use of the skeleton construction.

WITH the brickwork reduced to the function of a mere fire resistant, or used simply for looks, one would naturally expect the quality of the brick as to hardness to deteriorate. Indeed it is a question whether the extensive use of skeleton construction in some cities has not made possible the manufacture and sale of some notably inferior qualities of face brick. This, however, has not resulted from what could be called the best practice. On the contrary, every intelligent builder knows the absolute necessity of using the very best of brick in connection with steel construction, for the most vital part of the whole system is the endurance against corrosion of the steel itself. Unless the common brick is thoroughly well burned so as to be practically impervious to moisture, there is a great possible, though uncertain, danger to the structure itself, and consequently it is the practice of the best architects to use none but the very hardest and most thoroughly burned brick both in the external surface and for the fireproofing about the columns and beams. Although many inferior makes of face bricks have been sprung on the market and have found too credulous or too parsimonious customers, the extensive possibilities for external brick treatment which the skeleton construction can offer has opened so wide a market for the manufacture of moulded brick, fine qualities of face brick, and the more elaborate terra-cottas, that a distinct revival in burnt clay products might almost be traced directly to the introduction of steel construction. One has only to look over the advertising columns of any trade journal to see what a quantity of firms are engaged in the manufacture of brick and terra-cotta. A dozen years ago architects were tending towards the use of stone. Now the tendency seems to be directly the other way; and that our manufacturers are profiting by it is abundantly demonstrated by the excellent qualities of brick and terra-cotta which are now to be found in the market, which are in every respect far superior to what could be obtained before the steel construction came into use.

Another improvement has operated in connection with brick masonry as a direct result of the use of steel construction. The best experience tells us that the steel is most secure against corrosion when it is imbedded in the best quality of pure cement mortar. Consequently in the better class of work more care is now taken in filling the joints, and brickwork is laid up more solid in a better quality of mortar, than was the case when the walls fulfilled their expected functions in merely resisting dead load, and were made of ample thickness to allow for all the defects which usually accompanied brickwork. In other words, while as a supporting member a great deal less is now demanded of brickwork than ever before, a great deal more is demanded of it as to quality and perfection of mechanical workmanship in the laying. A structure erected in accordance with the best practice observed in the use of skeleton construction to-day affords a better opportunity for the brick manufacturer in both common and pressed brick, gives a better opportunity for the use of decorative terra-cottas, leaves the architect freer in the design of the masonry, uses a great deal more material, and is in every respect better built, more strongly constructed, and more thoroughly knit together than was possible with the system of construction which was used for large buildings a dozen years ago. Brick masonry as a supporting member disappears, and in its place there is a wide range of possibilities opened up for the most varied artistic treatment of clay products to an extent and of a quality which would have been impossible under former conditions.

FIREPROOFING.

A Department Conducted in the Interests of Building Construction to Prevent Loss by Fire.

FIREPROOF FLOOR ARCHES.

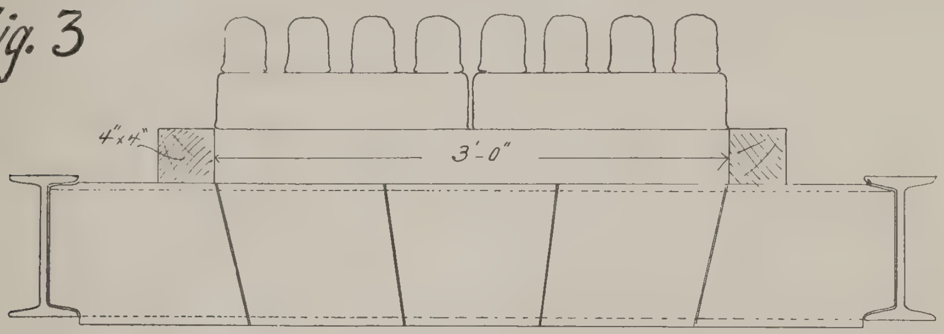
(*Continued.*)

BY GEORGE HILL, C. E.

PUBLISHED TESTS. — CONTINUED.

THE method of loading was secured by the application of pig iron, as shown by the sketch in Fig. 3, on three inches of sand filling which was placed over the arches, but we do not know whether the pig iron was all on the sand, or part on the sand and part on the wood, although one of the photographs seems to indicate that it was on the sand.

Fig. 3



This does not represent the condition which is actually obtained in the building, in which there is either a couple of inches of good concrete or else the ordinary common cinder filling and the sleepers and flooring. The method of applying the load was such as to make it difficult to destroy arches of high strength, also making it impossible to ascertain how the arch failed, since the mass of pig iron falling on the arch after it reached the ground was likely to smash many of the blocks by the impact, making it impossible to observe on what line the arch failed, losing another opportunity of determining which form of arch gave the most strength per square inch of effective section, and as a consequence which was the most economical from the point of view of the manufacturer. There are two points which should be noted in every test. They are, how the arch failed, and under what load; and any test which falls short of determining these must necessarily fall short of its full usefulness. Impact tests seem to be rather popular, really are of little utility, and simply of value as showing a special feature of one kind of arch material. They need not be further discussed. The fire and fire-and-water tests were unquestionably good so far as they went, but failed in the execution: first, because the stream of water was too small; and second, because the arch lacked its protecting covering of plaster, which under actual conditions it nearly always has. This made the result again open to dispute, raising the question of whether or not they truly showed how the material would act when in use in the building.

Any engineer taking up the general result of the static tests, with a knowledge of the usual practice of allowing a factor of safety of ten for mason work, will be surprised to see that these tests seem to show that the safe loads computed for nine square feet of area are from sixty-four pounds per square foot up to one hundred and seventy-three plus pounds per square foot, with a weight of the material alone of about forty-five pounds per square foot, which, with filling, plaster, flooring, etc., added, amounts to a total of about seventy-five pounds per square foot. When we compare this with the one thousand five hundred pounds strain, claimed by some makers, it is clear either that there is something radically wrong, or that no such factor of safety has been considered necessary by the maker. The subsequent tests will indicate the extreme irregularity of certain of the material, and perhaps afford some light on the subject of the proper factor to use.

When we note how these arches fail, we at once see a new light; those that fail did so at the skew backs. A glance at Fig. 2 will show why, since in each case the details indicate a weakness at the skew-back point, and in some cases an application of the bearing surfaces in such away as to invite exactly the shearing that occurred. If we calculate the shear per lineal foot, we will find that the arches sheared at 170 pounds per lineal foot upwards, which, if the factor of ten were applied, would limit the useful span of arches of this type to about three feet. These arches were tested when practically four days old, and as a consequence the mortar bedding, the skew backs to the beam flanges, even if well applied, was still too soft to prevent concentration of pressure at hard spots, or spots where the tile projected beyond the uniform line. As a consequence it would be possible for incipient failures to occur at one point, and then starting there, travel along the whole length of the skew backs from block to block with great rapidity, causing the failure of the whole mass, like a card house. In the case of the Lee arch, this bedding or lack of satisfactory bedding would not be of such consequence, since the bearing surfaces of each rib amounted to not more than two square inches.

In the Lee arch there were two thousand pounds per lineal foot safely carried, thus showing the crushing strength of the material per square inch to be above two hundred and fifty pounds; the shearing strength of the material was at least fifty pounds per square inch, and both of these results seemed to be very low, in the light of what we know of the compressive and shearing strength of such material.

In summarizing these results we may say that their principal use was to stimulate action in the line of better design of the arch-block section, and to demonstrate the weakness of the skew backs of the old style of construction. I think there can also be traced in the work of the manufacturers of terra-cotta a better design and a better realization of what the loads that the material are to be subjected to actually are.

Kindl Arch. (*Engineering News*, July 4, 1891, p. 3.) This is practically the Wilson arch, as was pointed out in a subsequent communication to the *Engineering News*, but differs from it in having greater depth for the suspending iron straps, and the using of hard-burned fire clay for the compression member instead of the concrete, both of these being decided improvements. It is shown in Fig. 4. The article descriptive of it says: "The practicability of this system was tested in a rude way, by building an experimental floor, as shown in Fig. 4. and loading it to the breaking point; this floor broke with a load of three hundred pounds per square foot, but if the material had been closely laid together, and a sufficient number of straps had been placed in the same, it would no doubt have been good for one thousand pounds per square foot."

This of course is quite evident; the actual safe load on the tile arch was about thirty pounds per square foot, or about that of the weight of the arch itself.

No information is given as to how the arch failed, and we therefore cannot draw any conclusions from the test; it would seem, however, as though too many questions of fidelity of workmanship were involved. Any little carelessness in the putting on of the straps, any improper bedding of the blocks to the straps, any carelessness in the putting up of the fire clay or properly wedging it at the ends, would all be likely to cause serious trouble, while if oxidation set in once it is certain that the small sections of the straps would soon be eaten away.

Cutshaw Test. (*Engineering News*, Nov. 14, 1891, p. 471.) These were made of the Empire Fireproof Construction Company's arches, single and double; the arches being made as shown in Fig. 5. These arches were covered with a thin layer of sand. Test No. 12 was made with a combination load of pig iron and brick; tests Nos. 11 and 13 were made with a load of pig iron alone, set on 1½-inch planks laid on the sand bed; all of the remaining tests were made by piling brick, and all of the loads were uniformly distributed over the area of the arch. The tests extended over a period between Nov. 15, 1890, and June 24, 1891, and are thus summarized by Col. Cutshaw:—

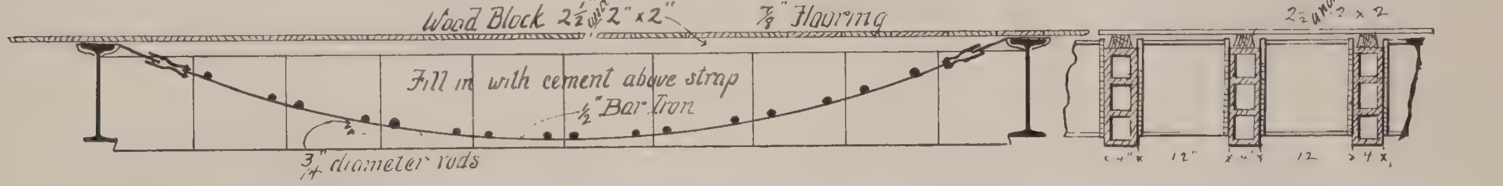


Fig. 4.

TABLE I.

TESTS OF THE EMPIRE COMPANY'S HOLLOW-ARCH BLOCKS LAID IN ROSENDALE CEMENT AND SAND MORTAR MIXED, 1 TO 2.

1st Test. — 6-inch blocks burned to a dark color.

Total Load, lbs.	Load per sq. ft. lbs.	Deflection, in.	Clear Span 3.95 ft.	Loaded area 9.25 sq. ft.	Set one week before loading.
2,695	291.3	1-3	Slight crack in cement joint underneath at centre.		
4,410	476.7	3-8			
5,551	600.1	5-8	Not broken.		

2d Test. — 6-inch blocks burned to a light color.

Total Load, lbs.	Load per sq. ft. lbs.	Deflection, in.	Clear Span 3.95 ft.	Loaded Area 9.25 sq. ft.	Set one week before loading.
980	105.9	1-12			
2,205	238.4	1-8	Beams spread 1-2 inch at bottom.		
3,675	397.3	5-16			
4,900	529.7	1-2			
5,355	579.		Arch collapsed.		

3d Test. — 6-inch blocks burned to a light color.

Total Load, lbs.	Load per sq. ft. lbs.	Deflection, in.	Clear Span 3.95 ft.	Loaded Area 9.39 sq. ft.	Set one week before loading.
980	104.4	0	Slight crack in cement joint underneath at centre.		
1,470	156.5	1-16			
2,205	234.8	1-8	Top flanges of beams approached each other 1-16 in.		
3,675	391.4	3-16			
4,613	491.3		Arch collapsed.		

Cambered 1-2 in.

4th Test. — 6-inch blocks burned to a light color.

Total Load, lbs.	Load per sq. ft. lbs.	Deflection, in.	Clear Span 3.95 ft.	Loaded Area 9.36 sq. ft.	Set 36 hours before loading.
735	78.5	1-16			
1,225	130.9	1-8	Slight crack in cement joint underneath at centre.		
1,715	183.2	5-32			
1,960	209.4	3-16			
2,450	261.5	7-32			
2,695	288.		Arch broken.		

5th Test. — 6-inch blocks burned to a light color.

Total Load, lbs.	Load per sq. ft. lbs.	Deflection, in.	Clear Span 3.47 ft.	Loaded Area 8.81 sq. ft.	Set 24 hours before loading.
735	83.4	1-32			
1,225	139.	1-16			
1,715	196.	3-32			
2,205	261.6	1-8			
3,241	367.9		Arch broken.		

Cambered 5-8 in.

6th Test. — 12-inch blocks burned to a dark color.

Total Load, lbs.	Load per sq. ft. lbs.	Deflection, in.	Clear Span 3.74 ft.	Loaded Area 8.23 sq. ft.	Set 40 days before loading.
950	125.	1-16			
1,782	236.	1-8			
3,089	408.	3-16			
5,352	708.	1-4			
5,352	708.	5-16	After interval of one hour stood 48 hours.		
5,572	736.	3-8			
7,603	1,005.	7-16	Left loaded for 8 days, no further deflection.		

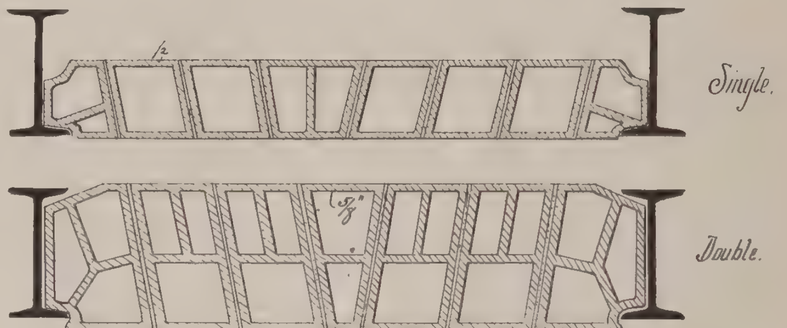


Fig. 5.

7th Test. — 12-inch arch burned to a light color.

Total Load, lbs	Load per sq. ft. lbs.	Deflection, in.	Clear Span 3 74 ft.	Loaded Area 8.23 sq ft.	Set 40 days before loading
4,752	576.	1-16	Deflection increased to 3-8 in. in 24 hours.		
5,950	720.	1-16			
6,415	778.		Collapsed in 4 hours.		

8th Test. — 12-inch arch burned to a very light color.

Total Load, lbs.	Load per sq. ft. lbs.	Deflection, in.	Clear Span 4.37 ft.	Loaded Area 11.43 sq. ft.	Set 20 days before loading.
3,168	227.	1-16	Crack in cement joint at key.		
4,752	415.5	1-8			
6,336	554.		Collapsed in 24 hours.		

9th Test. — 12-inch arch burned to a light color.

Total Load, lbs.	Load per sq. ft. lbs.	Deflection, in.	Clear Span 4.37 ft.	Loaded Area 11.45 sq. ft.	Set 20 days before loading.
3,168	277.	0			
4,752	415.5	1-8			
8,579	749.	1-4	Left on 48 hours.		
10,144	888.	5-16	Left on 48 hours.		
11,412	1,000.		Collapsed.		

10th Test. — 12-inch arch burned to a light color.

Total Load, lbs.	Load per sq. ft. lbs.	Deflection, in.	Clear Span 4.33 ft.	Loaded Area 11.34 sq. ft.	Set 37 days before loading.
1,180.8	102.	0			
1,771.2	153.	1-16			
2,066 4	178.5	1-16	Slight crack in cement joint, first block next skew back.		
2,656.8	229.5	1-8			
2,952.	225.		Slight crack in joint at key.		
3,542.4	306.	3-16			
4,428.	382.5	1 4			
5,904.	510.	1-4	Crack in key joint increased.		
6,494.4	561.	1-4	Stood with load 15 hours.		
7,084.8	612.2	5-16	Arch broken suddenly.		

11th Test. — 12-inch arch burned to a dark color.

Total Load, lbs.	Load per sq. ft. lbs.	Deflection, in.	Clear Span 4.33 ft.	Loaded Area 10.83 sq. ft.	Set 10 days before loading.
4,717	436.	1-16			
7,637	705.	1-8			
8,212	758.	3-16			
9,509	878.	1-2	Crack in cement joint second block		
9,701	896.	5-8	from skew back.		
11,445	1,057.		Arch collapsed.		

12th Test. — 12-inch arch burned to a dark color.

Total Load, lbs.	Load per sq. ft. lbs.	Deflection, in.	Clear Span 4.33 ft.	Loaded Area 11 sq. ft.	Set 19 days before loading.
3,599	327.	1-16			
6,442	586.	1-8			
8,442	768.		Collapsed.		

13th Test. — 12-inch arch burned to a dark color.

Total Load, lbs.	Load per sq. ft. lbs.	Deflection, in.	Clear Span 4.33 ft.	Loaded Area 11 sq ft.	Set 23 days before loading.
2,868	261.	1-16			
6,910	628.	1-3			
8,204	746.	3-16			
9,013	819.	1-4			
9,860	896.	1-2			
10,434	949.		Collapsed.		

The arches were carefully laid on rigid flat centres between I beams securely bolted together, and with joints of about one fourth inch, using shims of same material as arch blocks, where necessary to make close surfaces; and after standing till the mortar had set, a thin uniform layer of sand was spread over the arches, the centre removed and bricks placed on in regular courses till the arches broke. Tests one and six had reached prescribed limits of six hundred and one thousand pounds per square foot without breaking and were taken down. The loads of test twelve were made up of both bricks and pig iron, and of tests eleven and thirteen of pig iron alone with one and one half inch planks laid on the sand bed. These tests ran through a period of about seven months, from Nov. 15, 1890, to June 24, 1891. We may thus summarize the results: —

TABLE II.

Test.	Length along Arch Loaded.	Shear per lineal ft.	Safe Load per sq. ft. Factor of Safety 10.
1	2 ft. 4 in.*	1,190 lbs.	60 lbs. +
2	2 “ 4 “ *	1,155 “	57.9 “
3	2 “ 4 “ *	993 “	46.1 “
4	2 “ 4 “ *	575 “	28.8 “
5	2 “ 6 “ *	650 “	36.8 “
6	2 “ 3 “ *	1,700 “	100. “ +
7	2 “ 3 “ *	1,425 “	77.8 “
8	2 “ 7 1-2 “ *	1,210 “	55.4 “
9	2 “ 7 1-2 “ *	2,180 “	100. “
10	2 “ 7 1-2 “ *	1,350 “	61.2 “
11	2 “ 6 “ *	2,290 “	105.7 “
12	2 “ 6 1-2 “ *	1,685 “	76.8 “
13	2 “ 6 1-2 “ *	2,050 “	94.9 “

* Plus or minus.

Had these tests been accompanied with a note of some kind, as to where the first failure took place, they would have been the most valuable of any published so far as my observation goes, in so far as they determined the actual strength of the arches. Even as it is, by assuming that the sections were practically uniform, and of the thickness given, valuable results can be deduced by calculation from them. This however belongs to a later section.

It is quite evident that the design of the six-inch arch was very bad, but still worthy of note; that the carrying capacity of the skew backs, which are of better design than those shown in Fig. 2, have been much increased. It is also worthy of note that the double arch has come up to a reasonable amount in point of strength; a safe load approximating one hundred pounds per square foot having been attained.

Pioneer Company. (Catalogue.) “End pressure arch of hard tile, Fig. No. 6, shows section of the arch and skew back.”

The load per lineal foot of skew back was 1,315 pounds; the failure occurred under the load given on the sketch, generally the whole arch going at once; no special failure of the skew back was noted. The concentration gave $3,287\frac{1}{2}$ pounds per square foot of loaded area, showing a decided improvement in the style of arch.

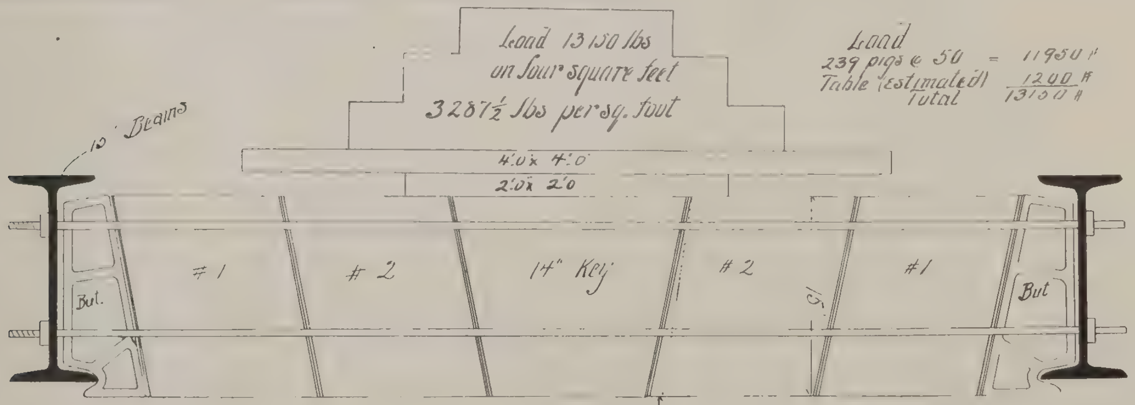
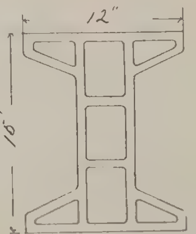


Fig. 6.

Joint opened here first and was about 1" wide before arch fell.



Section of Tile

A second test was made by impact, the log dropping on its side and finally knocking out four rows of an arch of six-foot span and five feet wide. The fifth row, one foot wide of six feet one and one half inches span, was left, although considerably jarred; this was then uniformly loaded with pig iron covering the entire area until 4,600 pounds was placed upon it, when the arch failed, the failure occurring first on the left-hand skew back at the point marked A on Fig. 7; the shear per lineal foot was 2,300 pounds, the safe load 76.7 pounds per square foot. This shows somewhat of a decrease from the above, but some allowance must be made, first for the failure of the skew back, which is not of good type; and second, for the shaking up which the arch received under the imposition of the impact test. The tie rods of these arches were but seven eighths inch in diameter, and probably the ends were not upset; no statement is made as to whether or not there was any elongation of the tie rod, but from our own observation we are inclined to think that such was the case to a considerable extent, thus forcing the concentration of pressure on a point which led to the failure.

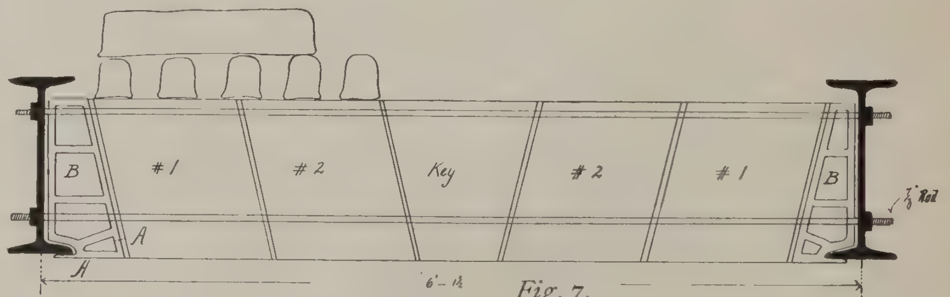


Fig. 7.

(*To be continued.*)

MORTARS AND CONCRETES.

A Department devoted to Advanced Methods of using CEMENTS and LIMES in Building Construction.

AMERICAN CEMENT.

III. — *Continued.*

Smeaton, in his "Narrative of the Eddystone Lighthouse," says: "It remains a curious question which I must leave to the learned naturalist and chemist, why an intermediate mixture of clay in the composition of limestone of any kind, either hard or soft, should render it capable of setting in water in a manner no pure lime I have yet seen, from any kind of stone whatsoever, has been capable of doing. It is easy to add clay in any proportion to a pure lime, but it produces no such effect; it is easy to add brick-dust, either finely or coarsely powdered, to such lime in any proportion also; but this seems unattended with any other effect than what arises from other bodies becoming porous and spongy, and therefore absorbent of water, as already hinted, and excepting what may reasonably be attributed to the irony particles that red brick-dust may contain. In short, I have as yet found no treatment of pure calcareous lime that rendered it more fit to set in water than it is by nature, except what is to be derived from the admixture of trass, pozzuolana, and some ferruginous substance of a similar nature."

It would seem that this description by Smeaton, as to the action of pure limes, coupled with his discovery as to the hydraulicity of impure ones, ought to have annihilated the ancient fallacy, but it did not.

Quoting again from Burnell: "Some curious facts might be mentioned, not only to show the influence of a large body of masonry in retarding the solidification of the mortar in the interior but also of the danger of using rich limes in cases where such masses are necessary. Amongst them we may mention a fact cited by Gen. Treussart, who had occasion to demolish in the year 1822 one of the bastions erected by Vauban in the citadel of Strasburg in the year 1666.

"In the interior, the lime after these 156 years was found to be as soft as though it were the first day on which it had been laid. Dr. John mentions that in demolishing a pillar nine feet in diameter, in the church of St. Peter at Berlin, which had been erected 80 years, the mortar was found to be perfectly soft in the interior. In both cases the lime used had been prepared from pure limestone."

It is not known whether these lime mortars were made by an admixture of sand, burnt clay, trass, or pozzuolana with the lime, but, so far as results are concerned, they would have been the same, for nothing is more certain than that pure lime, with or without admixture of any one or all of the materials named, cannot be induced to harden by simple mechanical mixture of these substances whether in air or water. It never has done so and never will. If fat lime can be made to assume an hydraulic character, by its admixture with pozzuolana, why did Smeaton seek further? He had the rich lime and he had the pozzuolana. Why did he not use them if he believed in the tradition that had been handed down through the centuries,—that such a combination, although purely mechanical, would harden under water?

If he believed that the Romans used this material in all their wonderful hydraulic cement constructions, why did he hesitate for a moment even? The answer is plain. Simply because he tried it in every conceivable way, as he himself states, and found it was not true, that such a mortar would harden under water. That is why he sought further. And yet, all who write of Smeaton, on the subject of his great discovery, while acknowledging that he found the ancient theory false, insist that the public shall deem it true.

It is quite true, that rich lime, or even hydraulic lime, takes very kindly to burnt and powdered clay, pulverized bricks, trass, or pozzuolana, all of which are substantially one and the same thing, the latter two, however, being of volcanic origin. No one of them contains inherent hydraulic qualities, and their mechanical incorporation with rich lime can in no manner render the latter hydraulic.

Although Smeaton used pozzuolana with the Aberthaw hydraulic lime in the construction of the Eddystone Lighthouse, yet it is doubtful if he would have done so had he not "fortunately found at Plymouth (where he was cutting and fitting the stones for the lighthouse) a considerable quantity of this material which a merchant had imported on speculation, expecting to sell it to the constructors of old Westminster bridge."

Henry Reid, in his work on "Portland Cement," London, 1877, states, "The Aberthaw lime in itself could have accomplished all he" (Smeaton) "desired, for he had unlocked the mystery of hydraulicity, and felt confident in the knowledge of its cause."

The composition of trass and pozzuolana will be found in the table of analyses.

Although Smeaton had discovered during the winter of 1756–57 that certain strata in the blue lias formation would, after calcination, produce an excellent hydraulic lime, it appears that he only made use of layers containing clay in such proportion as to cause his manufactured lime to slake by hydration.

It is very probable that he calcined some of the lower layers, but, finding they did not slake readily, confined himself to the use of such layers as would do so.

The idea of pulverizing such layers as would not slake readily, then testing them, and forming thereby a very energetic hydraulic cement, did not occur to him; and this is probably the point referred to by Burnell, wherein he states, as already quoted, "An illustration of the ease with which a very acute observer may stop short on this side of the attainment of a great truth."

In 1786 De Saussure found that the lime of Chamouni set under water, and, like Smeaton, attributed this faculty to the presence of clay.

Mr. Parker, of London, in the year 1796, took out a patent for the manufacture of what he called "Roman" cement from the septaria modules of the London clay formation found in the Isle of Sheppy.

This septaria was natural cement rock, and after calcination it was reduced to powder in mills suited to the purpose. This was undoubtedly the beginning of the natural rock cement industry in modern times. Its introduction by Parker was soon followed by its manufacture from the blue lias formation, and it went into general use throughout England.

Reid says, in speaking of Parker's Roman cement, "The Thames tunnel could not have been made but for the advantages it secured, and many of the early railway tunnels were built with it as a cementing agent."

Burnell, so late as 1868, in his work on "Limes and Mortars," states in regard to Roman cement, "Almost all of the works executed in water in England at the present day are executed with it."

In 1802 natural cement was produced at Boulogne, France. The rock at Boulogne is in the form of septaria, and is sometimes called "Boulogne pebbles." Its proportions of clay and carbonate of lime are such that it is used for the production of natural Portland cement.

In 1810 Edgar Dobbs, of Southwark, London, obtained a patent for the manufacture of artificial hydraulic lime or cement, by mixing together in suitable proportions carbonate of lime and clay, and after drying, he moulded or cut it into pieces before burning. He then states that "the burning must be sufficient to expel the carbonic acid from the lime without vitrifying any of the substances."

This is the first record we have of the production of artificial cement, or, as it was then called, "artificial hydraulic lime."

From 1813 to 1818 the artificial hydraulic limes were produced in France by M. Vicat, and by Dr. John of Berlin, and Raucourt de Charleville in Russia.

In 1824 one Joseph Aspdin, of Leeds, England, obtained a patent for the manufacture of an artificial cement which, in his specifications, he designated as "Portland cement."

This being the first time the word "Portland" was ever coupled with, or in any way mentioned in connection with cement, whether natural or artificial, there is no doubt whatever that Mr. Aspdin is entitled to the doubtful distinction of inventing the term, for certainly it is a most absurd and meaningless word so far as it relates to hydraulic cement.

Mr. Parker, on the other hand, had ample justification for naming his product "Roman cement," for he had but reproduced a cement substantially identical to that used by the Romans 1800 years before, and it is to be deeply regretted that the title he then employed did not thereafter cling to the natural rock cements the world over.

URIAH CUMMINGS.

(To be continued.)

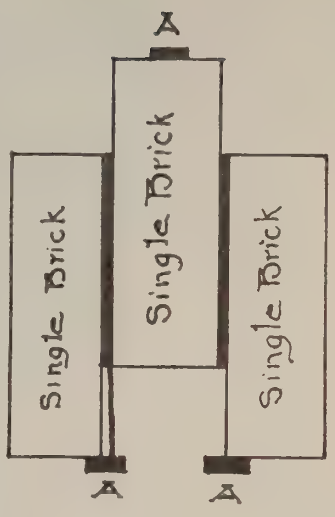
SHEARING TESTS OF MORTAR.

WHILE tests on the tensile, compressive, and transverse strengths of mortar are made in innumerable quantities every year, our knowledge of its shearing and adhesive strengths is somewhat meagre; and yet, whether the shear occurs through the body of the mortar or by sliding on the joint (whichever is the weaker of the two), a knowledge of the power required to cause this action must be always valuable and often needed.

With this end in view, experiments have been made by the author in the laboratories of McGill University on this subject.

The method of procedure was as follows: —

Three bricks were laid in mortar and tested, on end, as in the accompanying sketch. It was found necessary to place soft wood bearings at A, A, A, in order to do away with the transverse action, which tended to open out the joints; when this was done the action set up was practically a pure shear. In all, fifty-two tests were made on lime mortar 1 to 3 by weight, soft mortar; on natural cement mortar 1 to 1 1-2 by weight, 18 per cent water; on Portland cement mortar 1 to 3 by weight, 15 per cent water.



The mortars stood the following ordinary tests (see Table A).

The sand specimens were tamped lightly into the moulds, and were therefore quite near to practice in method of setting.

The following shearing results were obtained (see Table B).

In connection with these tests, experiments were made to determine the coefficients of friction between the surfaces after they had sheared. These were found to be: —

Lime-mortar surface on lime-mortar surface . .	.39
Natural cement mortar on brick surface . . .	.40
Portland cement mortar on brick surface . . .	.35

So that we are now able to determine some facts on the question.

The first one regarding lime mortar is that at one month old, at least, the adhesion is greater than the shearing strength, as in almost all cases the mortar sheared through at an average of ten pounds per square inch, regardless of the surfaces or thickness of joint, this being one third of the tensile strength at the same age, and one tenth of the compressive strength at the same age obtained on two-inch cakes and one-inch tension pieces.

Coming to the cement mortars we notice that —

1. The naturals are stronger in air, and the Portlands in water.

2. That the ratio of strengths in water, $\frac{38}{27}$, is exactly the same as tensile strength under water at the same age, *i. e.*, $\frac{132}{92}$.

TABLE A.

	Sp.	Time of Set.		Residues per cent.			Tensile Strength.							Compressive Strength.					
							Neat.			1 1-2 to 1.		3 to 1.		Neat.		1 1-2 to 1.		3 to 1.	
	Gr.	Incip.	Full.	50 Sieve.	80 Sieve.	120 Sieve.	3 days.	1 wk.	4 wks.	1 wk.	4 wks.	1 wk.	4 wks.	1 wk.	4 wks.	1 wk.	4 wks.	1 wk.	4 wks.
Lime												20	30						102
Natural Cement .	2.96	45′	2° 45′	2.9	11.7	21.4	99	150	268		132			1285	2255	250			
Portland Cement .	3.10	1° 0′	5° 0′	0.6	5.5	13.2	278	399	459			43	92	1362	2492			341	

TABLE B.

TABLE OF SHEARING TESTS OR MORTAR ADHESION TO BRICK SURFACES (IN SHEAR).

Kind of Mortar.	Joint.	Brick.	No. of Tests.	How Indurated.	Shear in lbs. per sq. inch.			Remarks.
					Average.	Least.	Greatest.	
Lime 1. Sand 3 . .	1-4″	A	5	In air.	9.7	8.4	11.9	All sheared through the mortar.
" " . .	1-2″	A	4	"	12.1	6.1	19.8	" " " " "
" " . .	1-4″	B	5	"	12.0	9.1	15 5	" " " " "
" " . .	1-2″	B	5	"	8.0	5.5	11.0	All came away from brick (mortar dry).
Natural Cement 1. Sand 1 1-2	1-4″	A	5	"	22.3	8.0	32.1	" " " " "
" "	1-2″	A	5	"	29.0	24.0	33.0	" " " " "
" "	1-4″	B	5	"	75.0	25.0	118.0	2 came away from brick, 3 sheared.
" "	1-2″	B	3	"	85.0	43.0	118.0	1 " " " " 2 "
" "	1-2″	B	3	In water.	38.0	34.0	42.0	All came away from brick.
Portland Cement 1. Sand 3 . .	1-4″	A	3	In air.	10.6	10.2	11.6	" " " " "
" " . .	1-4″	A	3	In water.	13.0	10.2	16.4	" " " " " The brick which was on top in the original laying always sheared 1st and at a less load than that of lower one, which, of course, set under twice as much load, or pressure.
" " . .	1-4″	B	3	In air.	16 5	9.2	24.2	" " " " "
" " . .	1-4″	B	3	In water.	27.1	20.2	36 9	" " " " "

A. Common, flat, unkeyed salmon brick.
B. La Prairie pressed brick, key on one side.

3. That the pressed bricks keyed on one side only give higher results than common bricks, and therefore that the adhesions to a pressed-brick surface on which the shears took place are higher than to ordinary brickwork.

4. The average of three natural cement tests which sheared through mortar was one hundred pounds per square inch, giving the true shearing strength; if the bricks had been keyed on both sides, no shears could be obtained through the Portland cement mortar.

5. Tests made on specimens kept in air showed conclusively the superiority of rich, natural cements for this kind of work, which is usually in air, over Portland cement mortars with a *heavier* dose of sand.

It was found that mortars must be very soft to give the best adhesive results, but this is probably old history.

With such facts as the above at hand, using the coefficients of friction obtained above, we can estimate fairly well what resistances such surfaces will offer against one course sliding over another.

Because this action seldom takes place is no reason for disregarding it; on the other hand, a knowledge of such points may enable us at times to economize in our design by counting in this adhesion along with our friction, which is usually looked to, to prevent sliding one course of masonry over another.

CECIL B. SMITH, MA. E.,
McGill University,
Jan. 15, 1895. Montreal.

SAULT STE. MARIE, MICH., Jan. 31, 1895.

EDITOR OF THE BRICKBUILDER, Boston, Mass.

Sir, — Without wishing to criticise the valuable article of Mr. Fred. T. Hodgson, C. E., on "Concretes, Cements, and Mortars: Old and New," which so abounds in practical hints, it may be of interest to call attention to a few points which appear to admit of question or require some explanation. It seems probable that in the very commendable effort to put a large subject in a small space, Mr. Hodgson may have left erroneous impressions on some of those readers of THE BRICKBUILDER who have not had time to look into the subject of cements very thoroughly, but who are, nevertheless, glad to receive such concisely stated information on the subject as Mr. Hodgson presents.

In the last paragraph of his article in the December number the inference would seem to be that two hundred and fifty pounds per square inch for briquets of neat Portland cement at the age of seven days is a high requirement. The present writer does not know of an English "standard," but turning to some of the best authorities on the subject we find that even as long ago as 1870, Mr. John Grant required three hundred and fifty pounds per square inch at seven days on the London Main Drainage Works. In 1890 Mr. Henry Faija, who was an eminent English authority, recommended three hundred and fifty pounds, and in 1893 he recommended three hundred and fifty to four hundred pounds per square inch. Mr. Maclay, of the New York Department of Docks, specified three hundred pounds per square inch in 1891, and many specifications require from three hundred and fifty to four hundred and fifty pounds per square inch.

On page 17 of the January issue the statement that the finest ground cement is the heaviest may be due to a misprint. Fine grinding of course lessens the weight per cubic foot.

The ratios given for the strength of various sand mortars to the strength of neat cement mortar may apply for short-time tests, or for a poor quality of cement or sand. Combinations of good sand with good cement give better relative results than are shown in the table of Mr. Hodgson. Conclusions drawn from the experiments of others are given in the following table in connection with those stated in the paper. The ratios are only approximate of course: —

Parts Sand to one of Cement.	Ratios of strength of Mortar to the strength of neat Cement Mortar.					
	F. T. Hodgson, C. E. Proportions by Volume.	John Grant, Proportions by Volume.	E. C. Clarke, Proportions by Volume.	I. O. Baker, Proportions by Volume.	Annual Report for 1893 of Col. O. M. Poe, Corps Eng'rs, U. S. A., Proportions by Weight,	Gen. Gilmore, Results at 1 year.
0	1	1	1	1	1	1
1	1-2	3-4	3-4	3-4	1	2-3
2	1-3	1-2	2-3	3-5	3-4	2-5
3	1-4	1-3	1-2	1-2 nearly	1-2	3-10
4	1-5	1-4		1-3	1-3	1-5
5	1-6	1-6	1-3 nearly	1-4	1-4	1-8

The statement on page 18 that "cements that set quickly in air harden slowly under water, and should not be used in such positions," is a very remarkable one. There are special reasons for using a quick-setting cement for submerged work. It is true that it is the general opinion that the ultimate strength attained by a quick-setting cement is less than that attained by a slow-setting one, but the advantages in the use of the former frequently outweigh the objection. *Extreme* activity is undesirable for obvious practical reasons as well as from the fact that cements that set in a very few minutes are apt to be defective.

That "all good cements require to be used immediately after mixing, or they will set on the mortar board and become useless"; and that "poor cements may stand longer, as they do not set so quickly," are also statements that would seem to require modification The author cannot mean that all good cements set "immediately," since he has said that cements that set quickly in air should not be used under water. Some cements which set in from twenty to thirty minutes and are thus "quick setting" are good, and on the other hand "good" cement may take from five to ten hours to set. It is also a fact that the opinion is gaining ground that mortar of moderately slow-setting cement may be left sometimes on the mortar board and remixed before use without injuring it, though of course this treatment is very liable to abuse.

L. C. SABIN.

BELOW we give the address of Mr. Robert Bevan, chairman of the meeting recently held in London by English manufacturers of Portland cement, for the purpose of forming an association to prevent he adulteration of cement.

In addition to Mr. Bevan's address, we print extracts from the remarks made by Mr. Leedham White, a prominent English manufacturer of Portland cement.

MR. ROBERT BEVAN. *Gentlemen*, — This meeting of cement manufacturers has been convened, not for the purpose of debating whether an association should be established, yes or no; you may take it that virtually an association is established to-day. Of course, those who form this association will be exceedingly glad to welcome every cement manufacturer who is prepared to join the association, under certain conditions, and those conditions I will explain presently. There may be differences of opinion amongst some of you. I dare say there are. I should judge that there are from the tenor of the correspondence that has come from the different cement manufacturers to Messrs. Renshaw, Kekewich & Smith, who convened this meeting. One or two of you have thought that the Chamber of Commerce of London would be the proper association; but I would just answer that suggestion by suggesting to those gentlemen who took that view that if the Chamber or Commerce had been desirous or competent to deal with this special subject which is under consideration, why have they not already done it? I really do not know what the names are of the members forming the Cement Committee, as I think it is called, of the London Chamber of Commerce; but it is just possible that they may be even members who have lent themselves to the practices which we reprobate. We, however, think it exceedingly desirable that this association, the purpose of which is single and restricted to one particular object, should be composed of those members of the trade who have utterly clean hands. We do not want to take advice in regard to the ulterior proposals that may be suggested for putting a stop to this very dangerous and inexpedient practice of adulterating. We do not propose to be associated with those who have not an entirely clean slate. It has been suggested — I think it was suggested in one of the public prints, but at all events it has been suggested among some who take a very great interest in this matter — that it would be desirable and absolutely necessary that those who become members of this association should be willing to sign a statutory declaration, taken before a commissioner of oaths, and I will read you the form of the statutory declaration which is suggested: —

"I, So-and-So, managing acting partner of the firm of Messrs. So-and-So; and I, So-and-So, resident manager of the cement works of Messrs. So-and-So, situate at": or in the case of a company, —

"I, So-and-So, managing director of such and such a company, and I, So-and-So, resident manager of the cement works of So-and-So, situate at So-and-So" (and where there is a limited company having several works it would be necessary that the managing director and the foreman or manager of each separate works should sign) "do solemnly and sincerely declare, that I am well acquainted with the practical manufacture of cement as carried on by the said firm or company, and that, according to the best of my knowledge, information, and belief, the said firm or company have not on any occasion, during the last three years, or within my knowledge at any other time, brought to and added to the calcined product of the kiln, in passing through the crushers or millstones or grinding machinery, or any other subsequent process, a separate supply of raw Kentish rag stone, other stone, furnace or oven ashes, disused or exhausted fire bricks, or any other material, so that such added material would be ground, sifted, or mixed together with the cement, and form part of the cement powder, and sent out and sold the cement in this state. And I make this solemn declaration, conscientiously believing the same to be true, and by virtue of the Statutory Declarations Act, 1835."

Now, gentlemen, of course, I am not going to suggest to other people to do what my firm are not willing to do, and have not done. There (*producing a document*) is our statutory declaration signed by our managing partner, Mr. Edmund Beven, and signed by Mr. James Weeks, the resident manager of our cement works. Now, of course, some gentlemen, I can readily understand, will rather object to sign this. Then, gentlemen, they are not eligible to be members of this association, that is all. Those who can sign it, I rather suspect, will sign it; but those who cannot sign it — of course I do not at all wish to say positively that every one who can sign it will, but I rather suspect that they will; but whatever view will be taken about signing this declaration, it is not a question for debate, because there are those who are willing to sign it, and, therefore, that is an association. But those who take a different view and think that something else ought to be signed — either that it may be permissible to mix these matters — and I understand from conversation that has taken place that there are one or two manufacturers who think it very permissible — if that be so, why, they can have another association, and they may call it what they like. It may be an Association for the Propagation of Adulterated Cement (*laughter*) or any other association that they please; but you will see from the way in which I have put it to you, that it is not between you and those — between any of you and others of you who are willing to become members of this association — it is not a debatable subject, whether or not an association should be formed, or whether or not if an association is formed this declaration will have to be undertaken. That, you see, is a settled matter, and that we do not debate. Then, of course, it may very properly be said by gentlemen here, "Well, but this comes upon us rather suddenly, and you know our Board of Direction does not meet for a few days, and we are individual members of the board, and we must take the authority of our board for the decision that we come to." Well, nothing can be more reasonable than that. Of course, this meeting will have to be adjourned. I can easily conceive that there are several and I trust a good many — and I trust all of us — who will be able to sign this declaration, and who are therefore eligible; but there may be a good many who cannot give a definite answer to-day, not being instructed by their board; and therefore nothing can be more reasonable than that there should be an adjournment of this meeting. But the purpose of an adjournment of this meeting is only to receive the signatures of those who will sign this declaration, and it is not at all for the purpose of debating whether it is an expedient thing, — whether you think it is for the advantage of the trade, or for the disadvantage of the trade. It is settled that there will be an association, and it is settled that no one will be a member of this association who cannot, under a statutory declaration, make this statement. I have told you that my firm have signed it; therefore, I think, at the present time, very little more remains to me than to invite the gentlemen who are able, without consulting their boards, or who are in a position to say that they are prepared to become members of this association on these terms, to express their willingness to sign. There is a gentleman here, a commissioner to receive oaths (*laughter*) who will be happy to take the statutory declararion (*laughter*) of any gentleman who would like to sign; so that you see everything is in an exceedingly businesslike shape, and in a forward state. I have no doubt that there will be some who will be quite willing to sign.

Mr. Leedham White. I wish it to be understood that I am not here to blow my own trumpet, or to advocate or push the firm of J. Bazley, White & Brothers; I am here speaking, as one who wishes to speak straightforwardly of what I know about the trade in general. Of course, this refers to the export trade. Now, my experience of the export trade, as the largest shippers of the article, leads me to exactly the opposite conclusion. I believe, on the contrary, and I say so, as having recently come from one of several visits to the United States, that the stress of competition, especially competition with these inferior foreign brands of natural cements, which are not really Portland cements at all, has put English firms on their mettle, and that not only we, but many other English manufacturers, who send cements all over the world, are actually sending even better qualities than we did a few years ago. I think it is most unfortunate, to say the least, that such statements, which are absolutely devoid of all foundation, should go forward at the present juncture to the public. I admit, gentlemen, that we have been distanced by German skill, and German competition, which is a different thing. I am most anxious that we should not be debarred from imitating German skill, — but that is the next point for us to consider, — because we have much to learn from the Germans. Otherwise, as I say, I came into this room in no hostile spirit to this proposition, and to what I supposed were the objects of the meeting, but rather prepared to indorse them. But whereas, on the face of that circular, it was impossible to read any other meaning in it, than that we were invited to come to this room to confer together as to the founding of an association, we are now asked to join an association which it is said has been already founded. Founded by whom, I should like to know? Any three tailors in Tooley Street might get up an association, and ask others to join it. We intend to join no association without very careful inquiry as to what lines that association intends to go on, because we do not want to be debarred, as people who intend to make progress in every shape and way, from taking advantage of scientific research. When I came into this room this afternoon I was perfectly ignorant as to this matter of Kentish rag stone, except from comparative hearsay, inasmuch as not a ton nor an ounce of that material has ever been used in any one of the four works under the control of J. Bazley, White & Brothers.

The Cotton States and International Exposition Company, Atlanta, Ga., intend to build in the grounds over "Clara Meer" a decorative concrete arch one hundred and fifty feet long. Plans from Mr. Fr. von Emperger, New York, are under consideration.

THE MASON CONTRACTOR.

A Department conducted in the interests of the Builder, and the Contractor for Brickwork.

ORNAMENTAL BRICK ARCHES.

IT often becomes necessary for the mason to cut his own arches, especially in the smaller buildings, and to do this correctly he should have a thorough knowledge of the manner in which to proceed. Of course in many of the larger structures the arches come on the job already cut, and all the mason has to do is to pick out the numbers and proceed to putting them in; but even if these ready-made arches are used, it is always best for the mason to know how to draw and cut his own.

The bricks used in these arches always show their thickness or edge in the face of the wall, which thickness generally being the full width of the brick at the extrados or outside of the arch, and diminishes toward the soffit or inside. This splay is termed the "sommering" of the arch.

The bricks used in external arches should be cut and rubbed with great care to the necessary wedge-like form, according to the gauges or regularly measured dimensions. This is not always done. Bricklayers are generally allowed sufficient time to rub the *outside* of each arch brick properly, so that their work may have a handsome appearance to the eye, but often slur over all the other parts of the work which are hidden from view. Hence in order to save time they are very apt to cut away the inside of the bricks of their arches to such a degree as may even deprive them of their proper wedge-like form everywhere except at the external surface. This neglect produces cracks, and causes the arch to bulge forward, and may even cause one of the bricks of a straight arch to drop down lower than the soffit at bottom of the arch, which defects may be frequently seen over the windows of many brick buildings. It is well known that all ornamental arches generally are nothing more than mere shells, as far as strength is concerned, and support only a portion of the outside of the wall. But if properly executed, well cut, rubbed, and set, they answer the purpose for which they are designed. It is therefore necessary that the mason should know this branch of the trade thoroughly.

Subjoined I place before him the forms of the principal brick arches in use throughout this country, and when he is called upon to construct any of these in practice, all that is necessary for him to do is to apply the rules for designing them as laid down here.

Every mason should have a pair of compasses, a T square, a set square, a drawing board, and his rule, and practise the drawing of these arches he is often called upon to construct.

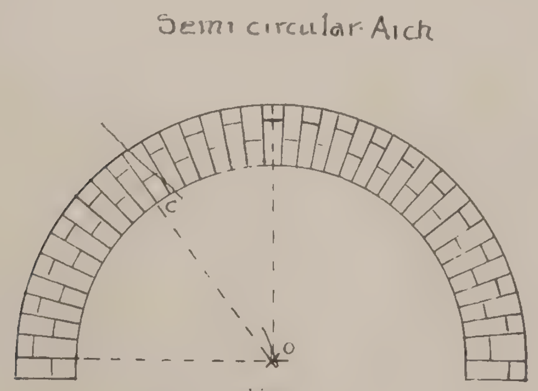


Fig. 1.

To draw and build a semicircular arch, place the point of the compass at the centre *O*, and with the radius *O C* describe the inner circle, which will answer for the soffit (see Fig. 1), then with the same centre describe the outer circle according to the depth required. The number of courses in a semicircular arch is determined by finding how many thicknesses of a brick (the kind to be used) are required at the extrados of the arch, allowing for the thickness of the joint, which is generally one eighth of an inch for pressed brick, and from these points of division drawing to the centre of the arch will determine the splay, and give the rule for rubbing the brick to their proper form. It must be remembered that all *bonded arches* must be spaced off into an odd number of courses, and the proper way to do this is to lay out the *key brick* first, divide it in the centre of the perpendicular line, from which space downwards to the springing line of the arch, making the number of spaces alike on both sides. The soffit line for the brick of the arch is got by placing a set bevel across the space occupied by one course of brick on the soffit line; this is reversed for the brick on the extrados line.

The segment arch may be worked in the same way as the preceding one, the only difference being in taking the centre line to strike it with. This is taken in the perpendicular line below the span, with radius according to the rise required, and this is the point to which all lines must be drawn, both to get the skew back, also the size of the course. (See Fig. 2.)

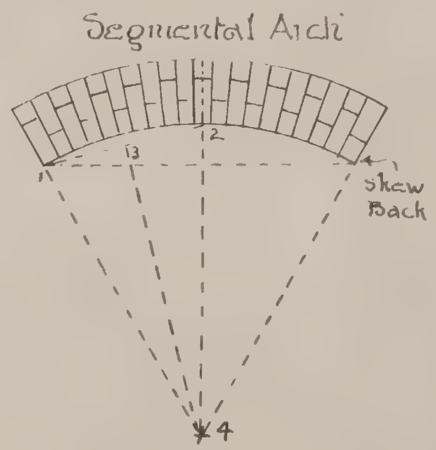


Fig. 2.

Draw the tangent line 1 2, bisect it at the point 3 at right angles with the line 1 and 2, which gives the line 3 and 4, the intersection of which with the perpendicular gives the centre from which the segmental curve of the arch is drawn, and also the point from which all the joints of the arch must radiate.

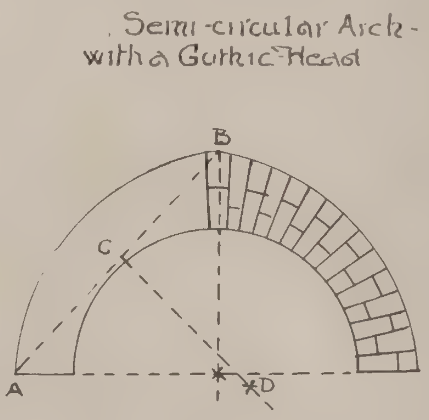


Fig. 3.

Semicircular Arch with Gothic Head. — To draw the outside portion of this arch, it is necessary to draw the line *A B*, bisect it at *C*, draw a line with the set square from *C* (see Fig. 3) at right angles with *A* and *B* to any point *D*, and upon this line the centre is taken to describe the outside curve of the arch according to the haunch required; and the inner ring must be divided in the same manner as the outer ring of the semicircular arch, but the bevels for the tops must be taken separately. If the depth of the arch be very deep, this inner circle must be so divided that the joint at the outer circle may not be too large.

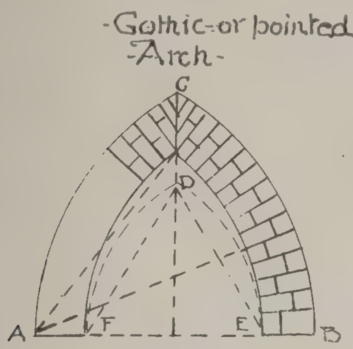


Fig. 4.

The Gothic or Pointed Arch. — (See Fig. 4.) Set out with the width of the arch *A B* on the horizontal line, then with *A* for centre and the distance *A B* for radius, describe the arc *C B*, then with *A E* as radius and with the same centre describe the inner arc *D E*; this forms one side of the arch; then with *B* as centre and same radius used for first half, describe the second. It will be observed that this is not the equilateral Gothic arch, which is shown, however, by the dotted lines within the pointed arch, and described by using the centre *E* and *F*, and is built as follows according to the pointed Gothic: Divide the extrados into courses according to the size of the bricks, and draw the lines to the point *A* as shown, taking care in dividing out the courses that half a course shall be on each side of the perpendicular line at *C* to answer for key brick. The bevel once set will answer for the whole of this arch, the same as semicircular. The mason should observe with attention the manner in which this arch is keyed, for in practice pointed arches are often botched in a ridiculous manner in this respect, simply because the mechanic did not know how to design it or was not allowed time to execute it properly. The best way is to draw the full size of the arch to be constructed first, form your moulds, cut and rub your brick to them, then, when everything is all right, put in your arch as quick as possible.

Sometimes the Gothic arch is cut as represented in the following figure (see Fig. 5), but it is very seldom, on account of the extra work in soffiting the bricks, for in this case each course must be cut to a separate bevel, and the lines for each course must be drawn from the centre *O*.

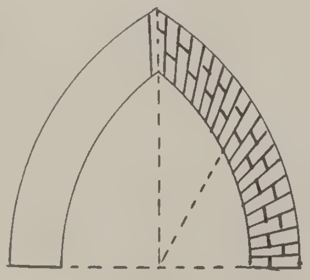


Fig. 5.

Modified Gothic. — (See Fig. 6.) To cut this arch it is necessary to draw the lines *A B* and *B C* at *D* and *E*, and from these points of bisection draw the lines to the points *F F* with the set square, and upon these lines the points are taken to describe the arch according to the depth required. The extrados is then divided into courses and lines drawn to the points *F F*, for the wedge shape of the brick if the arch is to be cut, in the same way as the Gothic arch; but if it is to be *keyed* in with an upright key, the lines must be drawn to the centre *O*.

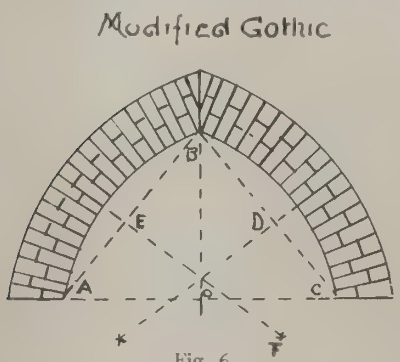


Fig. 6.

Segment Gothic. — (See Fig. 7.) To draw the segment Gothic, lay out the span *A B*, and describe the soffit from the perpendicular line according to the rise required as at *O*, the extrados of the arch is obtained as shown for the *modified Gothic.* Care should always be taken in laying out the courses of this arch that the key may appear as shown in the cut. The wedge-shape form of the brick is obtained from the centres *C C*. The soffit and cross joints are obtained from the centre *O*, but the extrados line of the arch must be cut from the centres *C C*, also the line of skew back.

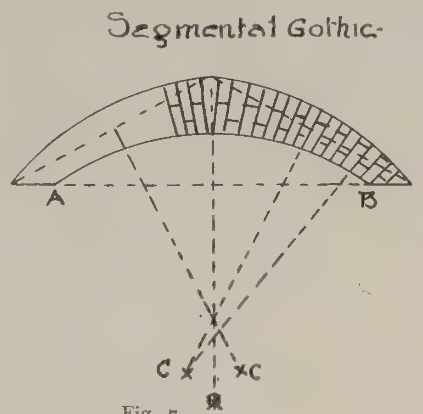


Fig. 7.

Camber Arch.—When the curve of the segmental arch is very flat, the centre from which it could be described is very distant from the intrados of the arch, the brick have their joints converging to points near the arch, and are all therefore cut to different forms, the arch is called a *camber arch.* It will be seen that in a straight arch of this kind no two bricks are alike on the same side of the key, but those on the opposite sides correspond with each other, pair by pair. The ordinary way to describe this arch is to lay out the width of the opening, draw the soffit line with a *camber slip* (a piece of board one half inch thick and as long as the opening, and triangular in shape, having a rise of one eighth inch to the foot toward the centre of the opening), bisect the perpendicular line with *C* as centre and *C B* as radius. This is the point to which the lines are drawn to get the proper skew back. It is then necessary to measure the bricks to see how they will work. If two and one half inches, set of one and one fourth inches on each side of the centre line *A*, and draw lines to the point *C*, as shown; this will give the shape of the moulds, of which there ought to be three, made of stiff cardboard, and about eighteen inches in length. If the arch is to be one foot in depth, and in proportion if more or less, then mark them all about three inches from the narrow end. Fix one of these upon the centre line as shown at *A*, so the line above mentioned shall be exactly at the soffit line of the arch, and then trace the other two alternately toward the skew back, keeping each line on the moulds to the soffit line each time. The bevels must be taken for each course, and marked on the mould ready for working. One bevel will answer for soffit, cross joint, and top of each course, if it is reversed for the two last named (see Fig. 8); but sometimes it would be best to leave the tops and cut them when setting the arch, for very often mistakes are made in taking the length of the courses with the templet. Be sure and have the cross joints in this arch level and the courses uniform. Plain as this arch appears to be, it is however difficult to execute properly in practice; the full size of the arch should be drawn first, and the moulds taken as described, of course allowance being made for the joint when the cardboard is being cut for the mould.

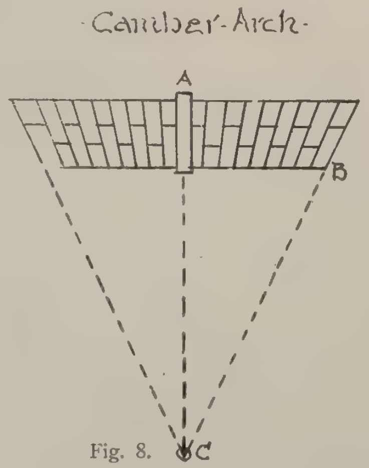


Fig. 8.

ARCHIE.

(*To be continued.*)

THE MANUFACTURER.

TIDINGS OF SPRING. — THE NEW ENGLAND MARKET.

AT this early day it is rather unsatisfactory to attempt to predict the building movement of the next season, especially in view of the unsettled condition of financial and business affairs. All that can be done is to state the conditions as they exist to-day in Boston and throughout New England, and to tell of the outlook as it now appears.

Brick building in Boston last year was unusually light up to the first of September, when a revival took place, which brought the total number of permits for new brick buildings to three hundred and ninety against three hundred and seventy-one the year before. This gain over the preceding year has been continued into 1895, and the permits granted up to middle of this month numbered forty-two, compared with thirty-four during the corresponding period of 1894, showing an increase of nearly twenty-five per cent, and this in spite of the unusually severe weather during the last three weeks.

There are reasons for believing that this increased activity will continue. It is generally conceded that the building of brick structures, stores, warehouses, and apartment houses has not been as large in comparison with the demand as has that of frame dwellings in the outlying wards and the suburban cities and towns. Frame apartment houses over three stories in height, now forbidden, will be allowed if certain amendments now before the Legislature, and likely to pass, are enacted. The increasing value of land in such districts as Roxbury and Dorchester, and in the centres of such places as Somerville, Cambridge, and many of the other cities of New England, make the erection of brick tenements and apartment houses more and more profitable and economical in the long run.

Another factor that is leading builders to use brick instead of wood is the nearer approach of the cost of the one to the other, the difference being narrowed constantly and, especially on high-priced land, making brick the cheapest material, considering what is obtained in the end.

The law which requires the fireproofing of the lower story and basement of a dwelling or tenement house, when the first story is used for other than domestic purposes, is very likely to be repealed. In fact it is almost sure to be, the insurance companies as well as the city and the builders being united in this movement. This will mean much to the brick makers, for the present law has put a stop to the building of houses with stores in them except on the highest priced land. It is believed that this change in the law will lead to a renewal of activity in the South End, and also the remodelling of many dwellings into stores on such streets as Columbus Avenue and Tremont Street, where the conditions would not warrant fireproofing as noted, but offer inducements to improvement without it. Even in the case of old buildings which are not entirely torn down this will lead to an increased demand for front brick, for in nearly every case a new front, more or less elaborate, is constructed when the alterations are made.

Another matter before the Legislature that will interest the terra-cotta manufacturers is a proposed amendment doing away with the masonry arches between the iron or steel beams in the construction of floors in first-class or fireproof buildings. This amendment would allow the substitution of wooden floors protected by fireproofing, such as metal lathing and plaster on the under side of the lower floor.

A number of large buildings in which brick will be used for the walls are in process of erection, or will soon be started in Boston. The most conspicuous and the largest is the new Tremont Building, to make way for which the old Tremont House is being torn down. It will have the eight upper stories built of light-colored face brick, and will cover a lot of nearly twenty-five thousand square feet. Winslow & Wetherell are the architects, and Norcross Brothers the contractors.

The Devonshire Building, of which Woodbury & Leighton are the builders, is another large office structure which calls for front brick. It will be on Washington, State, and Devonshire Streets, and the foundations are now going in.

Two large apartment hotels of brick are to be erected on Commonwealth Avenue. E. B. Horn is to build one, six stories in height, a short distance west of Massachusetts Avenve. Henry S. Mackay, of Mackay & Dunham, the architects, will build the other, between Hereford Street and Massachusetts Avenue. It will be ninety feet front and six stories high.

A new eight-story building is to go up on the corner of Tremont and Winter Streets, and another on the corner of Court Street and Cornhill. Both have been planned by Winslow & Wetherell, and brick and terra-cotta will be the principal materials used.

Even one not particularly interested in building must have noticed the great increase in the use of face brick and terra-cotta of late years in this vicinity. The State Street Exchange and the Ames building are almost the only conspicuous instances of the use of other material in an important mercantile structure recently erected, and both of these were erected before adoption of the steel frame principle of construction.

In the rebuilding following the disastrous fire of Thanksgiving day, 1889, brick was used in place of the stone that had melted before the flames. The new Farlow Building, a fireproof structure, which is going up on Lincoln Street, in place of the brownstone building destroyed in 1893, is to be built of brick. On the other side of Lincoln Street, on the corner of Essex Street, the Fred. Ames estate will build three five-story red brick buildings, aggregating over twenty thousand square feet in ground area.

A conspicuous illustration of modern construction, and a comparison with former methods showing the increased use of brick and terra-cotta, may be seen by any one who stands in Post-Office Square and looks first at the life-insurance buildings between Congress and Pearl Streets and then at the new Worthington Building on the corner of State and Congress Streets. The former are good examples of the employment of the heavy stone construction once so popular, and the latter of the newer school which employs the steel frame and the brick walls.

The beauties which lie in brick and terra-cotta skilfully handled are strikingly brought out in the new Castle Square Theatre, whose white walls and truly noble arch are a standing lesson in the artistic use of these materials, as well as objects of admiration to all who see them. Another building that has done much to show the possibilities of effective architectural work in brick is the Youth's Companion Building on Columbus Avenue, by many considered altogether the most satisfactory mercantile structure in Boston.

It is certain that not only has the use of clay products greatly increased the last few years, but that the demand for their employment in the best class of mercantile buildings is widening every day.

Considerable building of fine private dwellings on Bay State Road and other streets in the new Back Bay has been planned for this spring. The Roxbury "burned district" will also probably be rebuilt soon, and this time of brick. Driver & Dwight, architects, have plans for a large six-story apartment house in Dorchester, and W. A. & J. H. McGinty, for a large parochial school in the same district, both of which will be built this spring.

A demand has been made for a number of new schoolhouses for the city of Boston. Among those sure to be erected is a large one to be built on Myrtle Street.

Several large brick buildings will be erected by Ginn & Co. on First Street, Cambridge, to accommodate their publishing business. Another big brick building in the University city will be the new Middlesex registry of deeds, which will be begun some time this season.

The architects of this structure, Wait & Cutter, will also build an addition to the Lowell Court House.

Several new brick churches have been planned for suburban towns, among them a Methodist Temple for Cambridge, by Blackall & Newton, but this may not be begun this season.

In Lynn considerable new construction in the way of brick factories and mercantile buildings will take place, and several blocks are planned for Brockton.

Reports from Maine indicate a lively business there, and from all parts of New England come reports of a demand for new brick buildings, following reviving trade and industrial enterprise. It is impossible now to say that this promise of renewed activity will be fulfilled, but the outlook is generally regarded as hopeful.

Mr. F. N. Carter, Central Pressed Brick Co., Cleveland, has perfected a kiln which he claims is a great success in operation. He states that it is an entirely new departure from any kiln on the market, being built on the principle of a circular shaped continuous tunnel, so divided that the brick are subjected to a graduated heat from the green state to the maximum heat, and then gradually cooled to handling temperature. The manner of operation in this kiln is briefly as follows: the kiln itself is horizontal, the point of the greatest heat being midway in the circumference at equal distance from the two ends, wherein the circle of the whole is broken to admit of the entrance and extraction of the brick. The method of handling the bricks is as follows: they are laid in tiers of eight on specially constructed cars which traverse an iron track running through the entire kiln, and emerging at the same point, practically, as entering, after traversing the entire distance of the kiln. These cars are moved automatically in such a manner as to gradually approach the point of greatest heat, and after, to become gradually cool by passing from it to that of less temperature by the same onward movement of the car. Mr. Carter claims that the proper length of transit of this car to produce a properly burned brick need not to be over four days from the entrance of the green brick to exit of one perfectly burned. It should be understood that the principle of this kiln is continuous. One car follows another regularly, and as fast as may be; the speed being properly regulated to subject each car the required length of time to the burning process. The patentee claims that by his method of burning each brick may be made to assume the exact color of each and every other brick of the same composition; that the firing will be identical in degree of heat, and may be so regulated that absolute uniformity in burning can be guaranteed.

The Somerset & Johnsonburg Mfg. Co., are at present adding two new kilns to their works at Somerset, Mass. These have the capacity of twenty-two thousand each, and are built on the principle of the circular down-draft kilns.

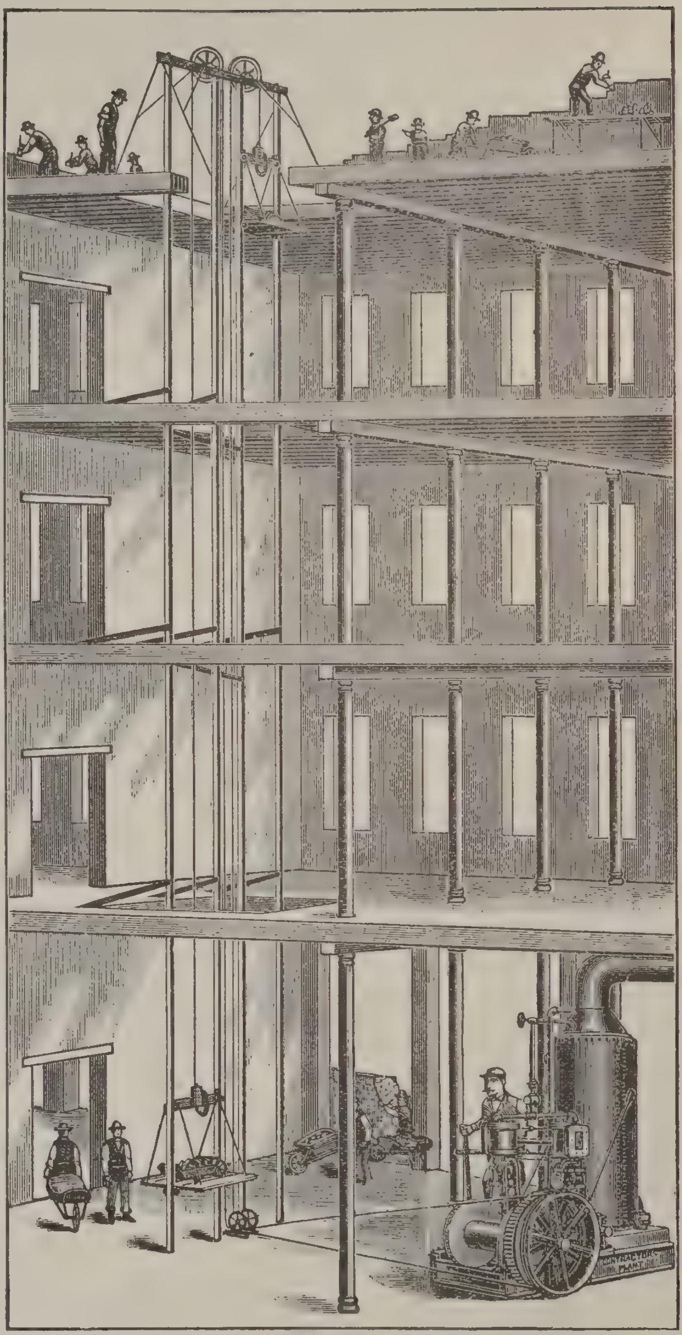
The Tiffany Pressed Brick Co., Chicago, have secured the contract for the enamelled brick to be used in the new City Hall at Jacksonville, Fla. It is probable that the entire lot will be white enamel.

The Empire Fire-Proofing Co., Pittsburg, are getting out material for the Moody Building at Buffalo. Messrs. Beebe & Son, architects.

The Industrial Press Brick Co., 46 South Street, New York, are making some alterations and extensions at their plant.

The Peerless Brick Co., Philadelphia, are about to increase the capacity of their yard.

The Winkle Terra-Cotta Co., of St. Louis, are building an extension to their works.



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VOLVME IIII MARCH 1895 NO·3

THE BRICKBVILDER

OFFICE 85 WATER STREET BOSTON

BRICK AND MARBLE IN THE MIDDLE AGES.

G. EDMUND STREET.

CHAPTER VIII.

(*Continued.*)

THERE is another respect in which St. Mark's is extremely Eastern. This is in the almost entire absence of figure sculpture in its original construction. The subjects and figures on the columns of the baldachin are too delicate to be noticed from a distance, and it was not until A. D. 1394 that the choir screen was introduced with figures of the apostles on either side of the rood, erected no doubt to supply a want which had been long felt before it was gratified. At the same time figures were added in niches between the gables of the exterior, but even now they form a small and inconsiderable part of the decoration of the church.

I have lingered on paper as I did in reality about St. Mark's; but if we wish to see Venice, we must tear ourselves away from it. We will go out by the baptistery, and here we are at once on the Piazzetta, the noble façade of the Ducal Palace on one side, and a great work of Sansovino's — the library of St. Mark — on the other; at the end of the Piazzetta are two monolithic granite columns, one of which bears the lion of St. Mark, the other the figure of the ancient patron saint of Venice, St. Theodore; between them is seen the dark blue line of the sea rippled into a thousand twinkling waves, and beyond this the Isola San Giorgio, remarkable for one of Palladio's churches,— a building, as I think, irredeemably ugly, but, nevertheless, much admired by many. If you walk down to the strand, where a hundred gondolas wait for hire,— some black and funereal-like, others dressed up with gay awnings, and all of them proud and swan-like with their bright steel prows rising lightly and high out of the water, — and then, turning round, look first down the Riva dei Schiavoni towards the sea, taking in the long sea front of the Ducal Palace, then the narrow gap bridged by the famous Bridge of Sighs, and on again, noting bridge after bridge, and the Gothic palace now turned into the Hotel Danieli, and then on to the promontory running out towards the Adriatic, occupied by the Public Gardens and planted with the only trees that Venice boasts, how lovely is the scene! or if, looking back up the Piazzetta to St. Mark's, noting the tall campanile and the quaint clock and clock tower beyond, and the domes and turrets, niches and figures, which crown the church, how much more vividly does it not impress the mind!

Venice is full to excess of striking pictures, and it would be endless to say in how very many respects it has a character of its own which can never be forgotten. The strange silence of its watery streets, broken only by the cry of the gondolier or the delicate plash of his oar in the water, is not the least impressive thing to the stranger; and when, after trying in vain to thread on foot the labyrinth of passages which confuse him irrecoverably in a few minutes, he commits himself to the dark recesses of a gondola, how delightful is the quiet, smooth, and yet rapid way in which, without more labor than is necessary in looking about, he finds himself now following the narrow winding of some small canal, awakening the echoes between the high walls of palaces or warehouses on either side of the way, or anon, upon turning with a graceful sweep into the smooth broad reach of the Grand Canal, making his gondolier move gently and slowly, as one by one the great palaces which grace its banks and form its retaining walls are carefully scanned, whilst the various and ever-changing perspective of the whole is dwelt upon, to be remembered afterwards with such intense pleasure!

From St. Mark's I remember trying to find my way to San Stefano, and taking a map of Venice, and calculating upon the orientation of the churches being fairly correct, I flattered myself that I might, without difficulty, make my way: the result was simply that for half an hour I was threading the mazes of all the passages around the church, and at last reached it only by chance; and I found afterwards that it would not at all do to take the churches as marking the cardinal points of the compass, for, as may be seen from the campanile of St. Mark, there are scarcely two churches in the city exactly alike in their orientation.

But pleasant as it is to recall one's recollections of highways and byways in Venice, I think if we wish to understand her architecture thoroughly we shall do well first of all to make a pilgrimage to Torcello, that sad and weird cathedral, standing forlorn and deserted on a wretched island in the lagoon, wherein we see the handiwork of the earliest Venetians, and the prototype of much of the later work in Venice itself. The story of Torcello has been told often, by no one with more feeling or more pathos than by Mr. Ruskin, and I need not attempt to repeat it. Suffice it to say that about A. D. 641 the church was first built, whilst in 864 it was restored; and being nearly decayed by age, was again most studiously repaired in 1008;[1] whilst in 1361, according to the testimony of Cornaro,[2] there was still standing on the same island divers churches (forty-two in number) adorned with columns of *pietra dura*, and with mosaics. Strange indeed is the difference here between then and now!

My first visit to Torcello was sad and sombre enough, to begin with. We started early from Venice in a thick mist, making our way first to the cemetery, where there is a good tall campanile, then to Murano, and through its shabby water streets passing the end of San Donato (which shall be described later), and then on through long canals, edged on either side by miles of green mud, and thronged with market boats and noisy boatmen. Here and there across the lagoon we saw a tall campanile marking the position of each settlement or island in this waste of sea and mud, and last of all that of the cathedral of Torcello, some five minutes' walk among decaying walls and unmown grass, from the half-ruined landing place to which our gondolier tied his boat. All that remains of the city is

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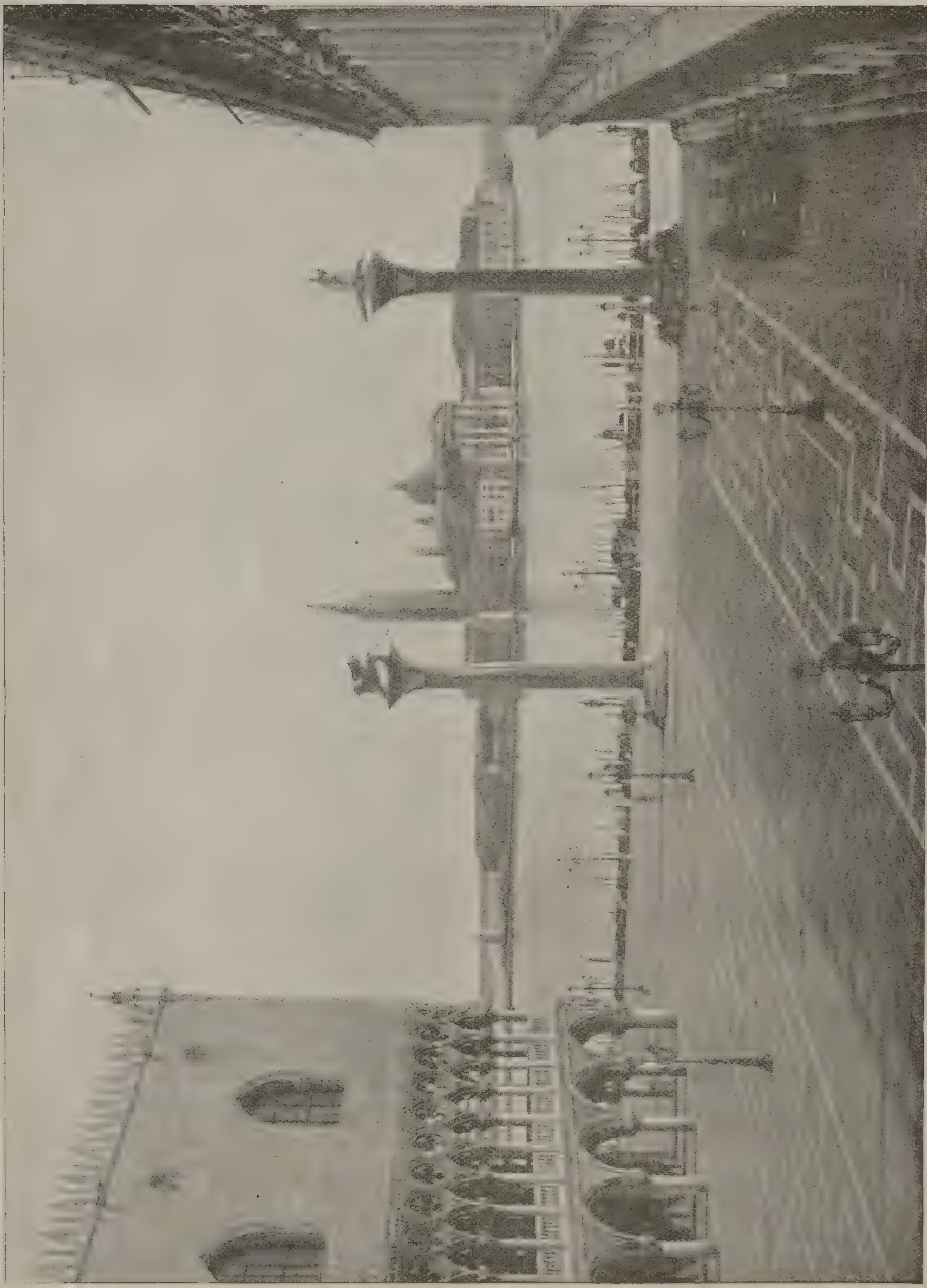
[1] Sagornino Chronicon, p. 119.

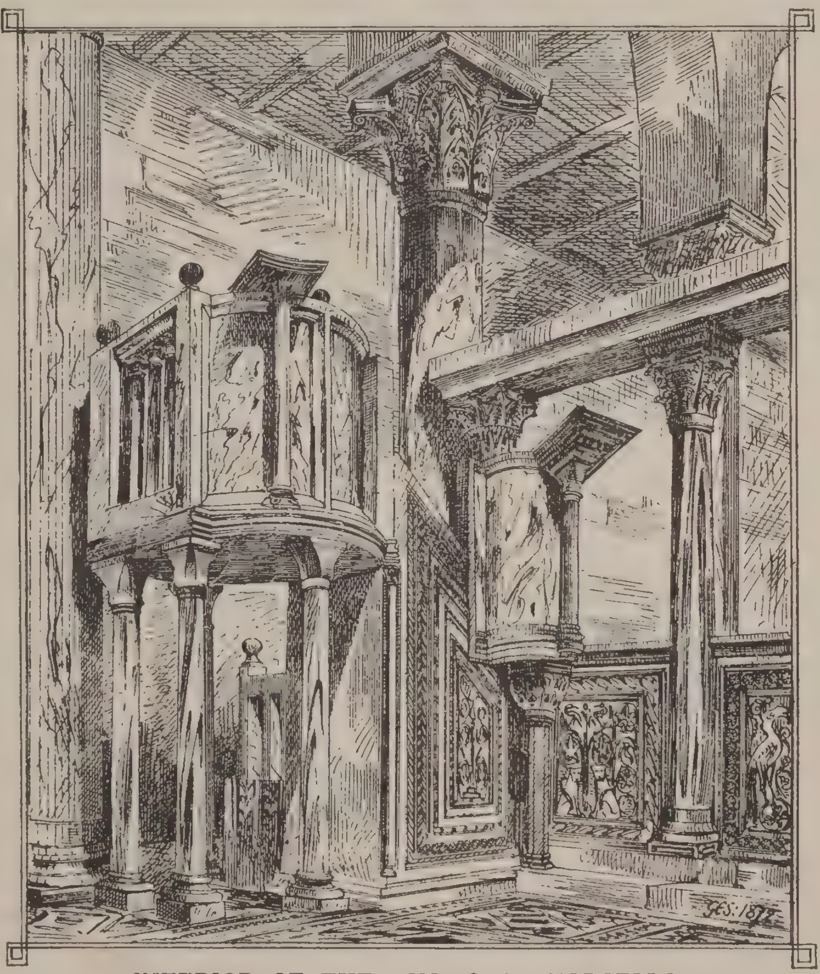
[2] Il Palazzo Ducale di Venezia, per Francesco Zanotto, I. p. 9.



PIAZZETTA AND SAN GIORGIO, VENICE.

Supplementary Illustration to "Brick and Marble in the Middle Ages."

before us in small compass. On the left a fourteenth-century building, said to have been the Palazzo Publico; in front, a stone seat or throne in the centre of what was once the market place; on the right, the Byzantine church of Sta. Fosca; and beyond, and connected with Sta. Fosca by a cloister, the modernized-looking cathedral, plain, bare, and uninteresting on the outside, with a detached campanile near the east end. This is all Torcello has to show; but forlorn and decayed as everything in the place is, it is precious in the highest degree to the architect who cares about the growth of his art. The cathedral is full of interest, though much damaged by extensive repairs, carried on in a reckless mood by the Austrians, not long before they lost Venetia, when new roofs were put on, and the mosaics were so much damaged that I remember collecting a handful of fragments from a barrow of rubbish before it was shot into the canal; at the same time a scaffold was erected for a proposed restoration of the great western mosaic, which, though threatened and indeed commenced in 1857, had not, in 1872, been proceeded with. The exterior has been completely modernized. In plan the cathedral consists of three parallel naves of ten bays, all finished with apses. The columns dividing the nave from the aisles are of veined marble, with capitals of exquisite workmanship, founded, indeed, on Corinthian examples, but modified by Byzantine influence and by study of nature. The arches are stilted and high; above them is a small clerestory of very simple windows. The central apse retains its raised rows of seats, though their brickwork alone is left; the throne for the bishop is placed in the centre, and retains some of its marble inlay. Under this raised east end a descending passage is formed, connecting the two smaller apses, and with a small apse formed in the thickness of the east wall opening into it. Three bays of the church are given to the choir, which is fenced round with richly sculptured marble screens. On the west the screen has marble columns, carrying a flat entablature, and below them is a solid portion some four feet high, covered with panels of flat sculpture, one having two peacocks drinking out of the same vase; another, two lions at the foot of a branching tree; and another, a complicated interlacing pattern of foliage. Such a screen is the obvious prototype of that in St. Mark's, and the sculptures with which it is adorned are evidently the work of some early Byzantine workman; whether brought from Aquileja from the ruins created by Attila's invasion, or wrought on the spot, I cannot say, but of a character which we still see in some of the nearly corresponding screens in the existing cathedral of Aquileja. Northwest of this rood-screen stands the marble *ambon*, a pulpit of two divisions, one (circular) facing south, the other (square) facing west. This and the staircase leading to it are full of delicate and good carved work. The arrangement has an absurd likeness to many a modern English scheme of pulpit and reading pew, and there is certainly force in an observation which Mr. Webb makes,[1] that such an arrangement would never have been thought of unless the gospel was to be understood by the people. Now they do not understand it; it is no longer said from an *ambon*, and *ambons* seem to be much less useful to Romans than rood-screens are to us!



INTERIOR OF THE DUOMO AT TORCELLO.

The screens north and south of the choir do not seem to be so old as the other, and are simple low screens.

In the mosaics of the apse and western wall we have, perhaps, the finest examples of Venetian mosaics. The apse is lined with slabs of veined marble below, and has above a mosaic of the Blessed Virgin Mary with our Lord and the twelve apostles, and the patron of the church, St. Heliodorus. The whole west hall is covered with a grand mosaic of the Crucifixion at the top, the Descent into Hell under it, and a Last Judgment at the base, which is carried down on each side of the west door, in the tympanum of which is a half figure of Our Lady. A mosaic at the end of the south aisle has our Lord with SS. Michael and Gabriel, and below them St. Gregory, St. Martin, St. Ambrose, and St. Austin.[2] Save where these mosaics occur, the walls have been persistently whitewashed, so that the appearance of the church is now far from attractive. It is not the less of great interest, as an example of a very early church founded on a Roman basilica, but with Byzantine influence most conspicuous in the sculpture of its ornaments.

Here, as in St. Mark's, the floor is paved with opus Alexandrinum, of which, in spite of damage done during the late repairs, it is a fine example. There is nothing to admire on the exterior, though the large stone shutters to the windows — single slabs of stone about four inches thick, working on stone pivots — have a most primitive air. The campanile has not much to distinguish it from others, but the top affords an interesting view of the lagoon and the sea with Venice in the distance, and the Alps of Friuli far away to the north.

A few yards through the cloister bring us to the church of Sta. Fosca. Here by the side of the Romanesque we have a capital example of a Byzantine plan, which seems to me to be of the greatest value in connection with the whole of the round-arched palaces of Venice, of which so many remains still exist. Sta. Fosca is a square church with small projections on the north, south, and west sides, and a deeper projection for the altar on the east. There are three eastern apses, and the western side is screened by an open cloister, which is octagnol in plan. The square centre is domed on very simple pendentives, and the capitals are similar in character to those in the cathedral. The best detail is to be seen outside the east end, where there is some good arcading and an enriched band of chevron ornament, formed by recessing the brickwork, and a mixture of red and buff brickwork which is very effective.

(*To be continued.*)

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[1] Continental Ecclesiology, p. 306.

[2] The mosaics here, as in Venice, are wholly of glass. The gold is covered with a thin film of glass, and the other colors used are dead white, black, dark and light blue, green, and red. The very smallness of the palette was here, just as it was with the old painters on glass, a distinct advantage, saving them from the bizarre and confused effect produced in such works by the use of too many colors or shades of colors.

THE ART OF BUILDING AMONG THE ROMANS.

Translated from the French of Auguste Choisy by Arthur J. Dillon.

CHAPTER II. — *Continued.*

CIRCULAR VAULTS. — *Continued.*

THE dome of the edifice which is called by the very doubtful name of "Minerva Medica" is a vault conceived in the same way, but one which contrasts strangely with the preceding one by its rude construction. I give in Plate XI. a partial view of the monument, and in Fig. 47 plans of the vault which are sufficient to show all its irregularity.

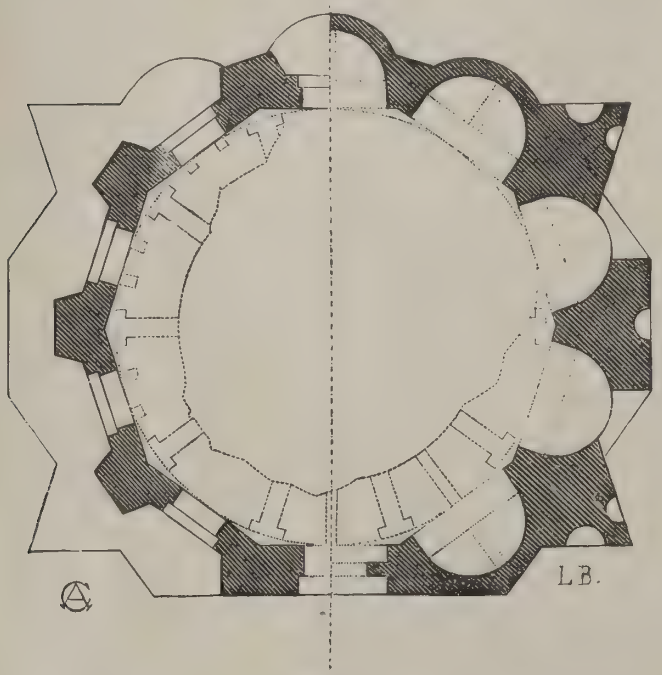


Fig. 47.

As long as one confines himself to the general conditions, the idea of the builders is quite clear. It was that of a dome placed by means of small pendentives on a decagonal drum. Ten ribs starting from the angles of the polygon divided its surfaces into ten equal parts. Some of the sections were further divided by secondary arches, and the whole formed a well-ordered armature which explains itself, and which can be comprehended at the first glance.

But when one examines the details there are to be found marked inaccuracies in the execution of such a simple conception and the clear traces of a poorly comprehended "parti." The brickwork, as though it had been given too great solidity on commencing, is suddenly simplified some metres above the springing, either through economy, or because in the course of building the first disposition adopted was found superfluous or too wasteful.

The principal ribs, corresponding to the angles of the drum, are composed of five single ribs at their bases, while at the crown there are but three; it might be claimed that this diminution resulted from the desire to give the ribs a width proportional to the circumference of the vault; but while this explanation taken alone might be admissible, a consideration of all the facts shows that the first hypothesis is the only true one, that is, that the armature is a mutilated work whose first conception, put for the moment into practice, was modified little by little in its principal parts.

This can be best seen by examining the interpolated work in the different sections of the dome. In one section there are two secondary ribs which stop almost as soon as they commence, and which, not being closed, are entirely useless. In another, a single rib was commenced and built up for a short distance, where it suddenly stops, so that, like the preceding ones, it is without utility; and in the last sections, the builder, fully convinced of the uselessness of the secondary arches, omitted them entirely. So that in the same vault can be seen sections subdivided by two incomplete ribs, others by single ribs, and still others with no division whatever. These arches, commenced, diminished, and abandoned, show experiments, and a hesitation not usually found in the monuments of Roman art. In fact, the Temple of Minerva Medica is clearly a work of the last days of Rome; the plan, as well as the exterior aspect, is marked by characteristics which point to a date which is perhaps quite close to that of the Byzantine Renaissance. The dome of the Baths of Agrippa shows the origin of the method, this one shows its decline, and they are, as it were, the two extremes of a tradition which endured, with remarakble persistence, during the long period of the Empire.

This should be the place to speak of the modifications of the methods applicable to spherical vaults when used in the construction of vaults of a quarter of a sphere or for *cul de fours*, and of how the combinations founded on the use of bricks laid flat were utilized for both. Plates XI., XII., and XIII. show this, I think, clearly enough, Plates XII. and XIII. giving two different models of armatures in the form of linings, while Plate XI. contains examples of large niches constructed on systems of isolated ribs. It is to be noticed what care the builder took to neutralize the thrust of the central rib which butts against the archivolt.

I will add but a single detail. In spherical vaults, where the construction of an armature is always a delicate operation, the Romans bound themselves even less than elsewhere to commence the armature at the springing of the vaults. They built the entire lower part up to a certain level, C, without any armatures of masonry and sometimes even without centres of any kind, guiding themselves by means of a cord equal in length to the radius, fixed at the centre of curvature. Among other examples there are, in the Baths of Caracalla, several vaults over exedras where this method was probably followed.

In order to keep faithfully to the condition I imposed on myself, — to describe ancient construction only through my personal examination of the buildings, — I should perhaps keep silent concerning the dome of the Pantheon; for this vault, covered with a thick coat of stucco, shows us only a series of caissons with no apparent indication of its skeleton. But nevertheless I will, on account of the importance of the edifice, seek the aid of a foreign witness.

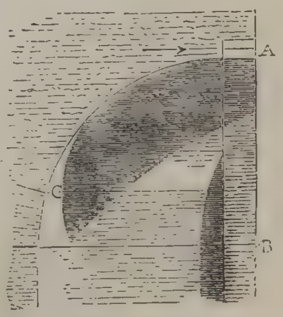


Fig. 48.

Piranesi had an opportunity of studying the detail of the vault when it was repaired under the pontificate of Benoit XIV. The plastering, partly destroyed by time, had to be removed and replaced by a new coating at several points. For this purpose a movable scaffolding was built, pivoted at the summit of the dome and running along the projection of the cornice; and Piranesi, who wished to preserve in his drawings the vestiges of ancient Rome, profited by this ingenious apparatus to observe the smallest details of the dome, of which he could examine the entire interior surface.

Conjectures enter to a regrettable degree into his works, but here nevertheless his testimony merits a certain amount of confidence; the circumstances in which he was placed should be something of a guarantee of his accuracy, and the care he took in drawing the parts of the edifice which are still visible vouches, in a measure, for those things which we cannot to-day verify.

The preceding figure (Fig. 49) is an exact reproduction of a drawing in which Piranesi shows a section equal to an eighth of the vault.

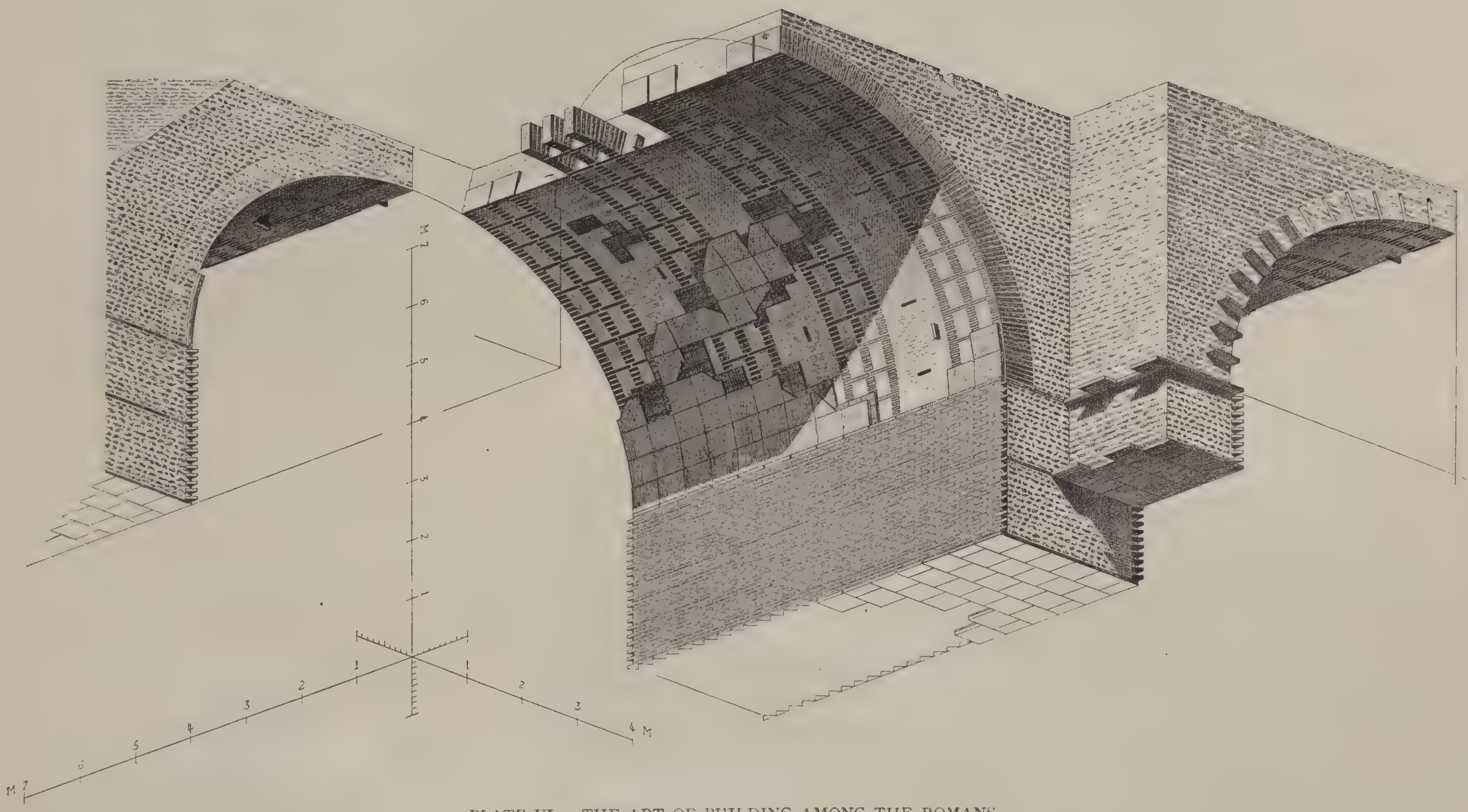


PLATE VI.—THE ART OF BUILDING AMONG THE ROMANS.

In the Pantheon, as in the Temple of Minerva Medica, the framework of the vault consists of a system of meridional ribs C, C. Relieving arches B, B prevent these ribs from bearing on the hollow parts of the drum, and small arches D, D divide into smaller compartments the large sections comprised between two consecutive meridional ribs.

The reason for all the lower parts of the armature can be read in their forms, so we will examine the arrangement of the upper part of this framework of brick.

The two sketches (Figs. 51 and 50) show at two stages of its progress the construction of the upper part of the work, which was, I think, built at two different times. At the summit the meridian ribs C, C originally terminated in the manner indicated in Fig. 50, their inward thrust being received by the ring of bricks E, which formed a border about the circular opening in the summit of the vault, the pressure being distributed over the entire circumference by means of the eight tangent arches O, O.

With the aid of these eight arches the border E of the opening could resist the pressure of the meridional ribs for some time; but as the thrusts increased as the rubble rose, it was more and more compressed until it would be in danger of being crushed. Its resistance was thought sufficient as long as the rubble did not rise above the level N, but when it reached this point it seemed prudent to duplicate all the system about the summit. A second ring, S S S, was built concentric with the eye, and just as the border E E of the eye was braced by the tangent arches O, O, so the new ring was sustained by a series of arches T, T, shown in the figure to the right.

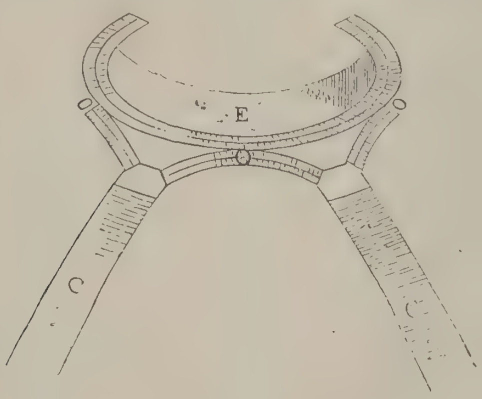


Fig. 50

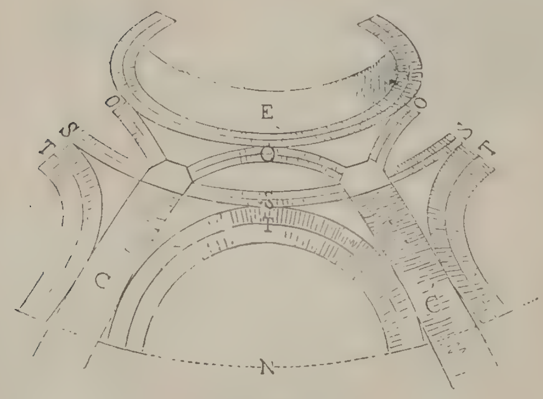


Fig. 51.

Such is the origin of the arches T, T and of the ring S, which constitute the difference between Figs. 51 and 50. And this is not an imaginary explanation; the second ring S, concentric with the border of the eye, could not have existed without the support of the arches T, and these last could not have been built until the rubble had reached the level N, for otherwise their bases would have had no support, they would have had nothing to rest on. Hence the relative dates we have given to the upper parts of the work are certain, and necessarily so. The large meridian ribs C were maintained only by the ring E during the first period of the work, and it was only when the filling had reached the level N that it was necessary to reinforce it by the second ring S S, which encircles it at some distance. This succession of parts once admitted, the *rôle* and the form of the armature are entirely explained, and the process which was followed can be conceived without the slightest difficulty. Be that as it may, we present this effort toward an explanation as a hypothesis subject to correction, calling the attention of observers to the circumstances capable of clearing up the questions which arise at the sight of this colossal dome. An existence of nineteen centuries seems a sufficient guarantee of the value of the processes followed; and certain knowledge of these methods would not only give a valuable aid in the advancement of the art of building, but also important facts to the history of ancient architecture.

The dome of the Pantheon rests directly on a circular drum. This was the primitive form of the Roman domes, the form of the round domes of the Baths of Agrippa (Plate X.), and that of all the domed halls built in the earlier part of the Empire. We called attention to the use of pendentives when describing the dome of the Temple of Minerva Medica, but they were brought into use in Roman architecture at a very late date, and the greater part of the examples which could be cited belong to that period of decadence which followed the reign of Diocletian and preceded the Byzantine Renaissance. In the Temple of Minerva Medica the dome is carried by means of pendentives on a decagonal plan; in the Torre de' Schaivi the dome was carried by rudely formed pendentives on an octagonal plan; and in a monument that belongs to ancient rather than to Byzantine art, in the tomb of Placida, at Ravenna, is a dome — the one in the central part — on a square plan. Thus was foreshown, step by step, the wide application of the use of pendentives, from which the architects of the time of Justinian, in the sixth century, were to develop an entirely original system of construction.

(*To be continued.*)

TO DRAUGHTSMEN.

ANY draughtsman out of employment, who will send us his full address and answer the following questions: —

By whom were you last employed?
Can you furnish good recommendations from your last employer?
On what particular line of work have you been engaged?
What salary do you expect to receive?
Are you willing to go to another city?

may have his name placed in our Exchange Bureau, and will be notified of any parties desiring his services as a draughtsman.

All such communications will be regarded as confidential, and no charge will be made.

Address,
Exchange Bureau,
The Brickbuilder Publishing Co.

TO ARCHITECTS.

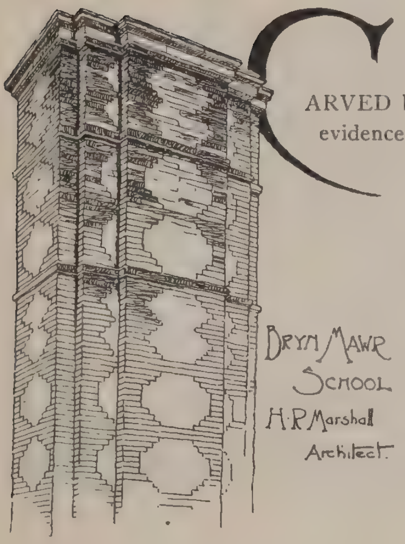
WE call your attention to the foregoing announcement, and upon your application would be pleased to put you in communication with any draughtsman whom we think would meet your requirements. All communications will be regarded as confidential, and no charge will be made.

Address,
Exchange Bureau,
The Brickbuildeb Publishing Co.

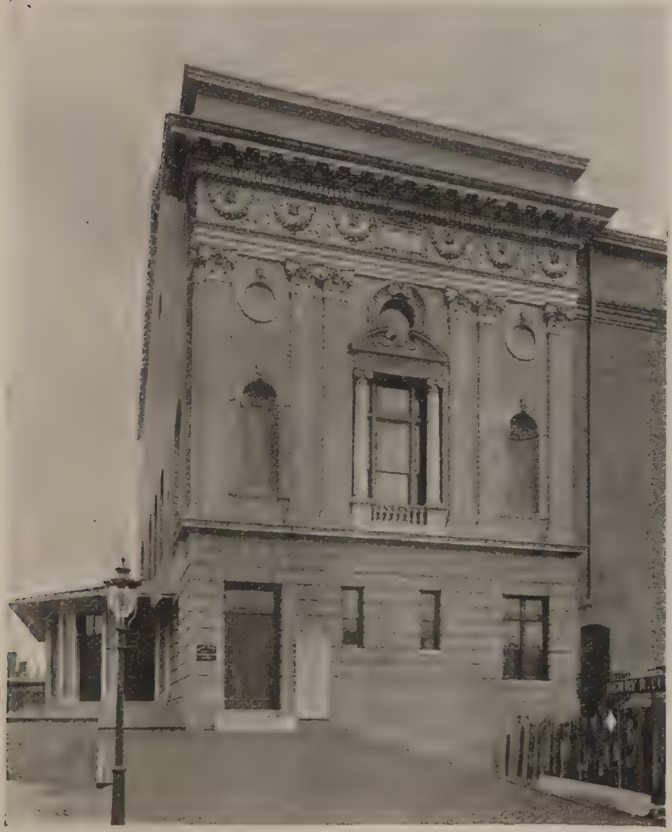
WE desire to call attention to the announcement of competition which we make in another column. It is proposed to have a series of these competitions, which will be judged by a jury of experts. We desire by these competitions to stimulate a thoughtful expressiveness in brick and terra-cotta designs, and while wishing to encourage that best kind of originality, which grows out of the endeavor to give the clearest and most poetical expression to new conditions, we commend also to those who take part a careful study of the best work of the past, and would urge designers to remember that nothing is beautiful that is not fit.

Recent Brick and Terra-Cotta Work in American Cities.

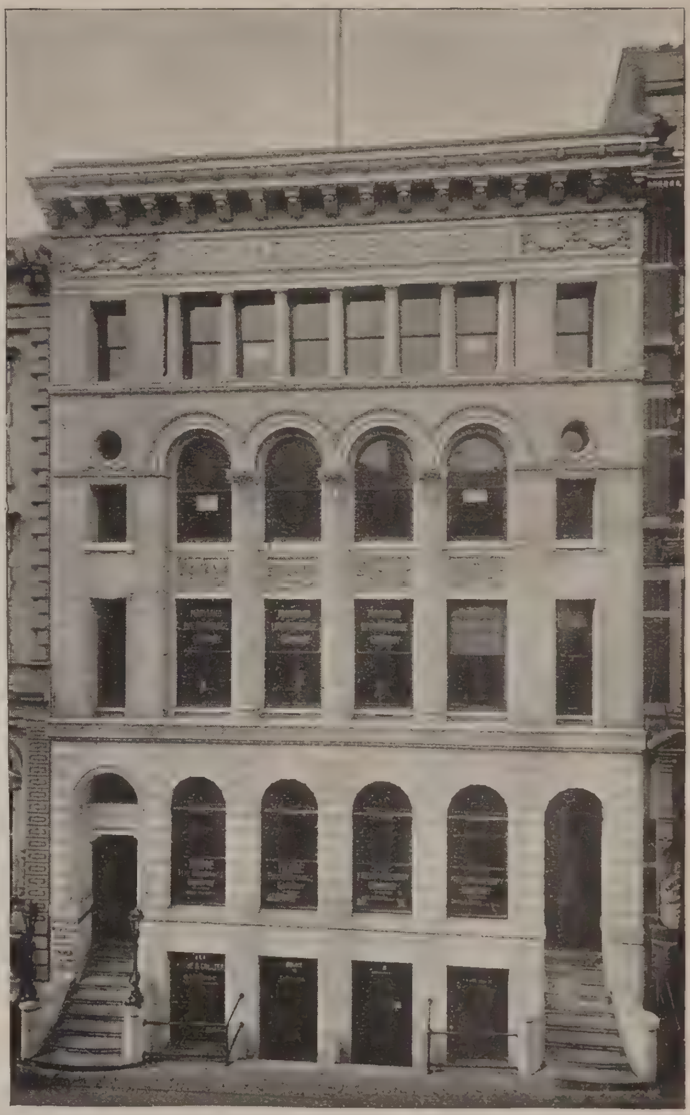
BALTIMORE.



CARVED brick, which at one time gave evidence in Baltimore of becoming a legitimate and permanent feature in architectural decoration, and seemed to lend itself freely to artistic treatment, with effects not attainable in moulded work, has never been used in Baltimore to any extent, a few fairly good examples appearing at one time, when that kind of work first became prominent some years ago, but they did not develop into anything more extended, and of later years we know of nothing of the kind that has been done in any way. It is asserted that the quality of the Baltimore brick, while superior in all other points, does not lend itself to tooled work with the same success as that of the clay from some other localities, of Philadelphia, for instance; but we are not able to say with authority whether this statement is an actual fact, or merely the result of prejudice on the part of those who are opposed to any innovations into time-honored methods, and the contamination of good mechanical processes by any freehand, artistic touches that would not be amenable to a two-foot rule. About the same period a small amount of excellent work of the kind was done in Washington, notably some of the details on dwellings designed by the late Mr. Richardson, but there also no further progress was made, and we remember no carved brick of late years in the national capital.

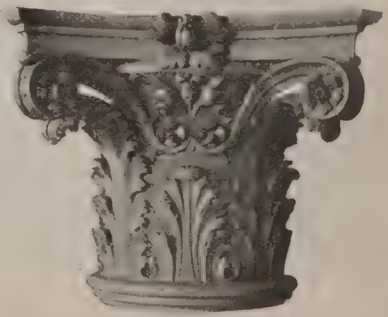


MUSIC HALL, BALTIMORE.
T. Henry Randall, Architect.



MARYLAND LIFE INSURANCE COMPANY'S BUILDING,
BALTIMORE. Jos. Evans Sperry, Architect.

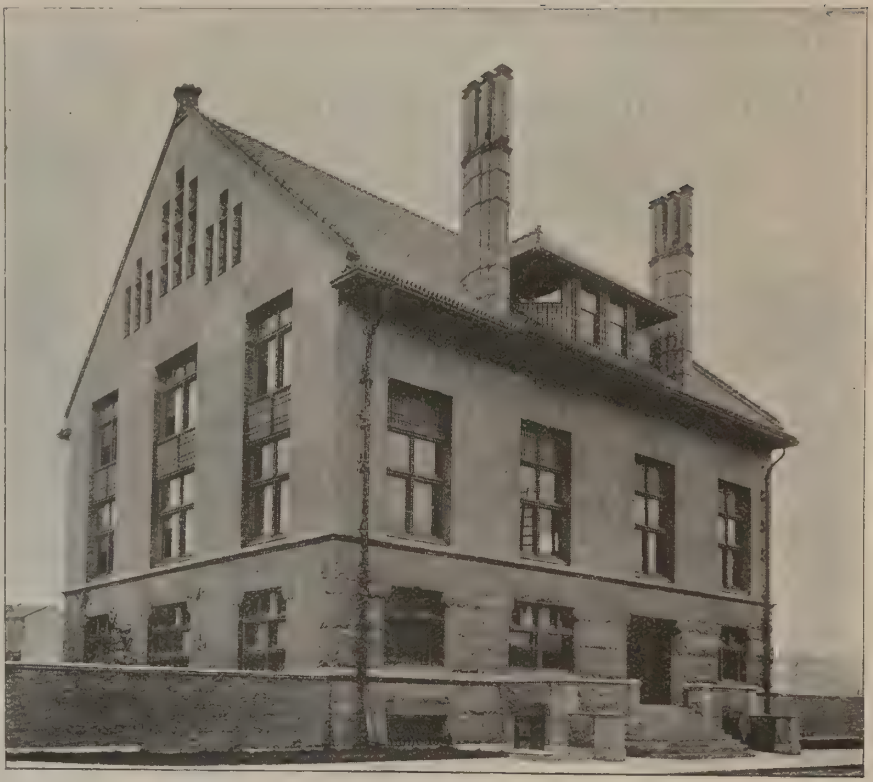
Upon five conspicuous buildings, erected in the last few years, is to be found nearly all the important terra-cotta work done within that period, used as the prominent decorative feature of the design, combined with brick and stone in the construction. These five buildings are the Equitable Life Insurance, from the office of the late Mr. C. L. Carson; the new Music Hall, designed by Mr. T. Henry Randall; the Drovers and Mechanics Bank, and the Maryland Life Insurance, by Mr. J. E. Sperry; and the façade of the Johns Hopkins Hospital, designed by Cabot & Chandler. Of the Equitable Building we have



TERRA-COTTA CAPITAL, MARYLAND
LIFE INSURANCE CO.'S BUILDING.

not been able to obtain a desirable view or detail drawings; it is, however, the largest and most important ten-story office building in the city, and as a design a very satisfactory combination of buff brick and terra-cotta upon a granite base.

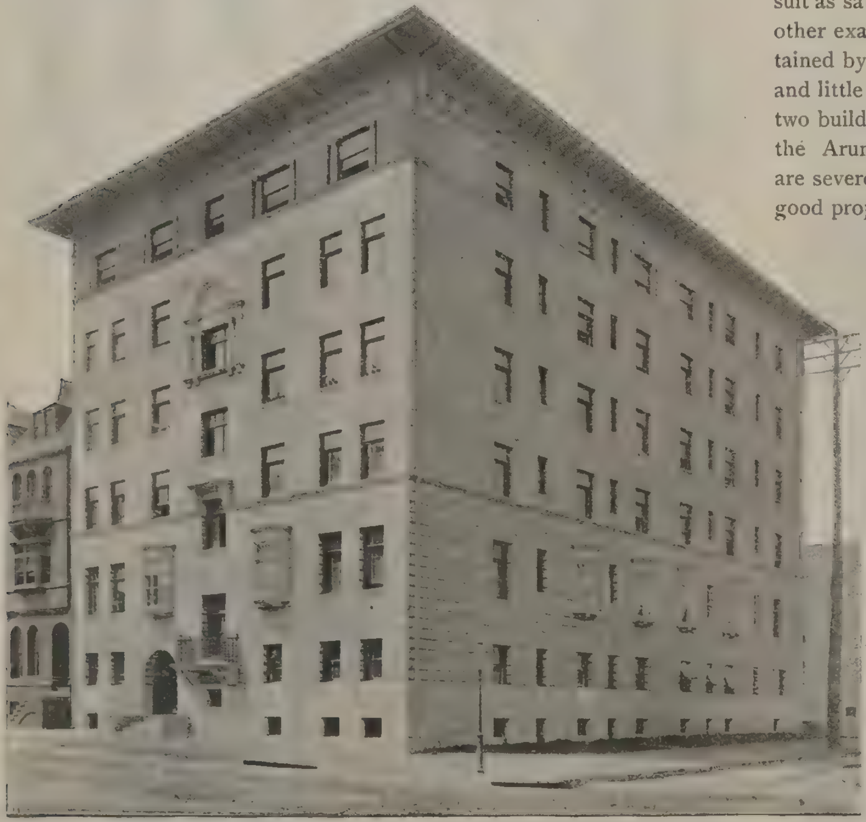
The new Music Hall, of which we show both photographic view and detail drawing, while as yet devoid of its principal façade (the construction of which is temporarily postponed, from point of economy), gives sufficient evidence, in the pavilion already completed, of the highly ornate style of the design, eminently appropriate for a building of that character, and showing a liberal use of florid detail with a rich combination of yellow tones, that, when completed, will render it one of the most successful expressions of a large concert hall that has lately been produced. Its adaptation to special conditions of the somewhat peculiar surroundings of its site is not so happy, and its merits will never be seen to the same advantage as if it were otherwise located. The very simple and inexpensive design of its rear elevation, constructed of ordinary brick with flat pilasters having terra-cotta caps, is an evidence of how a fairly good thing may be done with cheap materials by a mere careful consideration of proportions.



BRYN MAWR SCHOOL. H. R. MARSHALL, ARCHITECT.

The Maryland Life Building, a combination of buff brick and terra-cotta on a white marble base, shows also a very satisfactory façade, the terra-cotta Corinthian columns supporting the arches, giving it a monumental and classic aspect, with detail appropriate to the material, and the total result is harmonious, producing generally a very satisfactory impression upon the public, who, we usually find, in the long run, approve of a good thing, even if they may not know why. The construction of the cornice, by means of a species of iron brackets bolted into the wall and upon which the terra-cotta is partly hung, is worthy of notice. Another prominent building, by the same architect, as yet unfinished, is that of the Baltimore Herald, also buff brick and terra-cotta on a white marble base; the terra-cotta detail around the windows and in the top story, forming a sort of frieze to the whole design, is very ornate; but the general tone of the brickwork, showing a pale, pinkish tinge, does not produce a result as satisfactory in color, in the whole combination, as that of the other examples mentioned. As examples of successful results obtained by the simple use of bricks in flat designs of harmonious colors and little other ornamentation, among the best we know of are the two buildings shown, the Bryn Mawr School, by T. R. Marshall, and the Arundel apartment house, by Wyatt & Nölting. Both buildings are severely simple and plain in form, both have interest from the good proportion of their flat wall spaces and openings, with few details beyond a cornice or balcony in one, or a tall chimney design in the other; both are more or less expressive on the exterior of the respective purpose of the building, but both derive by far the larger part of their claims to our interest in the color treatment in brick of their flat surfaces. In the school building this is a dark, rich combination of warm browns and buffs, above a massively treated reddish brownstone basement, and with a gold-brown tile roof, while in the Arundel the effect is a bright, golden buff, clear and clean, but varied, combined with a pattern in a red old gold and a cream-color sandstone. With these buildings we close the list of those at present worthy of special note in Baltimore, for any particularly good use of brick or terra-cotta work.

J. B. NOLL WYATT.



ARUNDEL APARTMENTS. WYATT & NÖLTING, ARCHITECTS.
Golden Buff Brick by Sayre & Fisher Co.

FOURTH PRESBYTERIAN CHURCH, INDIANAPOLIS, IND.

W. AND G. AUDSLEY, ARCHITECTS, NEW YORK.

THIS church, erected at the northeast corner of Alabama and Tenth Streets, Indianapolis, is a small but highly satisfactory specimen of brick and terra-cotta church architecture. The exterior is of rich red brick, relieved by bands of chocolate brick; and the whole of the finishings, including the tracery of the three rose windows and the frames of all the other windows, are of deep buff terra-cotta. It is to the harmonious effect of color — red, chocolate, and buff — that much of the beauty of the building is due. The buttress weatherings are formed of brick, set diagonally, and are highly satisfactory in work. The design of the exterior is somewhat severe, and is entirely devoid of effort or straining after meretricious effect. Plates 23 and 24 show elevation and plans.

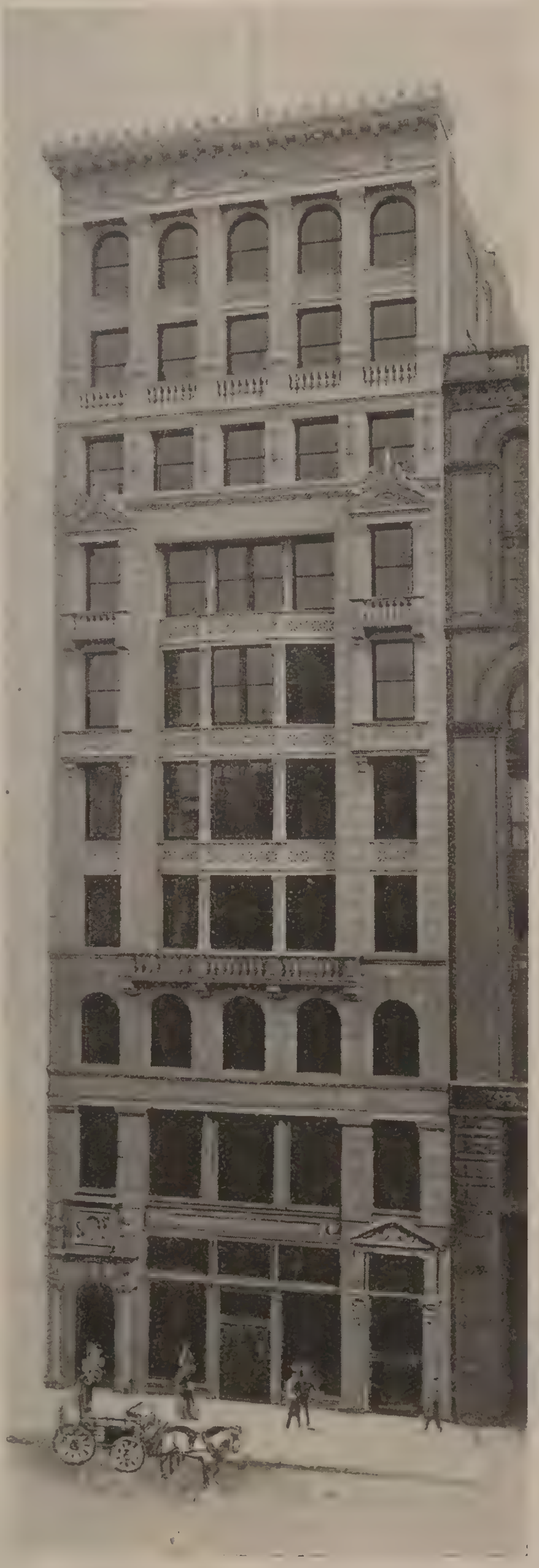
ONE of the striking examples of recent brick and terra-cotta work in New York City is the store building 704, 706 Broadway, DeLemos & Cordes, architects. The façade is built of white brick and terra-cotta, the brick being of the same kind as those used by Carrère & Hastings in the Jefferson Hotel at Richmond.

PLATES 19 and 20 illustrate elevation and plans of a colonial residence designed by J. William Shaw, Philadelphia, and built of brick, Flemish bond with black headers.

NEW ADVERTISEMENTS.

ON page xv may be found the new and very attractive advertisement of the Conkling-Armstrong Terra-Cotta Co., Philadelphia. Messrs. Armstrong and Conkling have been long and favorably known in connection with the manufacture of architectural terra-cotta, and bring to their new enterprise that skill which is obtained only by years of experience. Their new plant is most admirably situated at Tioga, Philadelphia, and has been equipped with the most improved machinery.

We would announce to those interested that Mr. Chas. E. Willard has recently opened an office at 171 Devonshire Street, Boston, and carries a full line of brick, terra-cotta, tile, drain pipe, metallic paint, lime, etc., representing a number of companies well known in these particular lines. The fine display which Mr. Willard has erected in his office is certainly well worth visiting; there are some sixty different styles and shades of brick arranged in such manner as to bring out just what effects may be produced in the way of combination of colors and styles of brick. Such an exhibit gives a more accurate idea of the appearance of any particular shade of brick when "laid up" than could be obtained by single samples. We certainly feel that a display of this kind is of decided benefit and should be encouraged.



STORES 704, 706 BROADWAY, NEW YORK.

White Brick Furnished by the Powhatan Clay Manufacturing Co., Richmond.

Mr. Willard does not enter this field as a stranger. His long connection with one of the best known firms in the country has brought him many acquaintances and friends, who extend to him their best wishes for success.

For details regarding the lines he represents we would refer to his advertisement on page xiv.

BRICKBUILDER COMPETITIONS.

WE desire to announce a competition open to all draughtsmen who are subscribers to THE BRICKBUILDER, for a city house of brick. The house is to have a frontage of twenty-five feet on the street. The lot is eighty feet deep. The house will have four stories over the basement, and its cost must not exceed $16,000. The front will be of brick, with architectural detail of moulded pressed brick, taken from the catalogues of our advertisers, or of pressed brick and terra-cotta; colored faience may be introduced into the ornamentation if desired. The drawings will be made in line with black ink on two sheets, cut to the uniform size of 14″ x 18″. One sheet will show the elevation at a scale of one fourth inch to the foot; the other, the plans of the first and second floors at a scale of one eighth inch to the foot, and details of the façade (especially the cornice) at a scale of one half inch to the foot. The style of brick bond adopted must be clearly shown on the elevation. Drawings must be received at the office of THE BRICKBUILDER not later than the first day of June. THE BRICKBUILDER offers a first prize of $60, a second prize of $40, and a third prize of $20. In addition to these prizes, THE BRICKBUILDER offers a special prize of $40 for that design, *accompanied by specifications*, for a similar brick house, of fire-proof construction throughout, which can be executed at the lowest cost. In awarding this special prize, only those designs will be admitted to competition which reach a certain standard of excellence in design; but beyond that, the awarding of the prize will depend on the excellence and the economy of the construction called for in the specifications. Designs unaccompanied by specifications will be regarded as being entered only for competition for the first three prizes. This special prize may be taken by one of the winners of the other prizes, or by another, as the case may be. The question of cost will be submitted to an expert builder. The prizes will be awarded by a jury of three architects of acknowledged reputation.

Each drawing must be marked with a motto or cipher, and a sealed envelope similarly marked, containing the full name and address of the designer, must accompany the drawings. These envelopes will not be opened until after the award is made.

THE BRICKBUILDER reserves the right to publish the prize designs and the prize specification. Other drawings may be published with the permission of their authors. At the conclusion of the competition all drawings will be returned to competitors. Drawings must be delivered flat, express or postage prepaid.

DRAUGHTSMEN WANTED

To confer with us as to how they may obtain a *free subscription* to THE BRICKBUILDER for 1895.

We can only accommodate a limited number in each city. If you wish to be included, we would advise your writing us at an early date.

THE BRICKBUILDER PUBLISHING CO.
85 WATER ST., BOSTON.

OUR ILLUSTRATED ADVERTISEMENTS.

THE church of San Giacomo Maggiore — or St. James the greater — at Bologna is the subject of the plate published this month by the Hydraulic Press Brick Co. (See page xix.) The apse and campanile were begun in the thirteenth century, but the church was not finished until the fifteenth century. The top of the tower and the arcades along the side of the church are of the later date. Arcades of similar character protect the sidewalks of most of the Bolognese streets, and form one of the pleasantest and most characteristic features of the street architecture of the city.

Madonna and Child, by Andrea della Robbia, is the subject of this month's illustration by The Atwood Faience Company. (See page xvii.) It is from a photograph of the original in the sacristy of the church of Santa Croce, Florence.

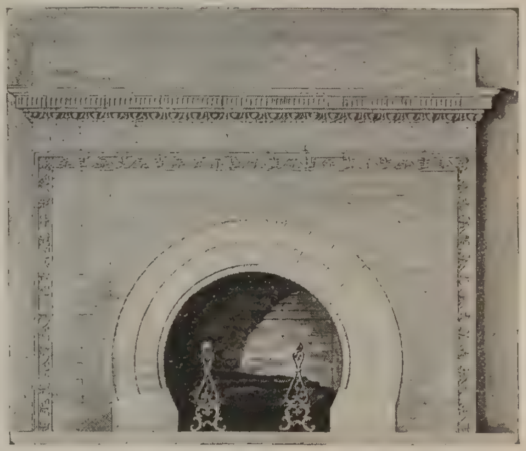
The accompanying illustrations are of terra-cotta detail used in the façade of the Post Graduate Hospital, New York, which is illustrated in the advertisement of the New York Architectural Terra-Cotta Company, on page xviii.

The Chamber of Commerce Building, Rochester, N. Y., another example of recent brickwork, is illustrated in the advertisement of the Eastern Hydraulic Press Brick Company, on page xx.

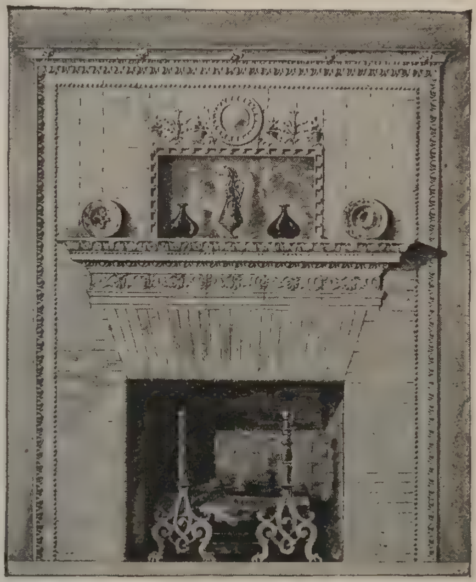
THE MECHANICVILLE BRICK COMPANY, Mechanicville, New York, write us as follows: "Some time ago we read in THE BRICKBUILDER an article on Roman brick made in common red brick, and opinions of different architects in regard to same. Inspired by the article we have fitted up for making such brick, and are prepared to furnish them in quantities."

THE AMERICAN CERAMIC TERRA-COTTA CO., Chicago, have secured the contract for the terra-cotta on the Yerxes Observatory to be erected at Geneva. Mr. Henry Ives Cobb, architect.

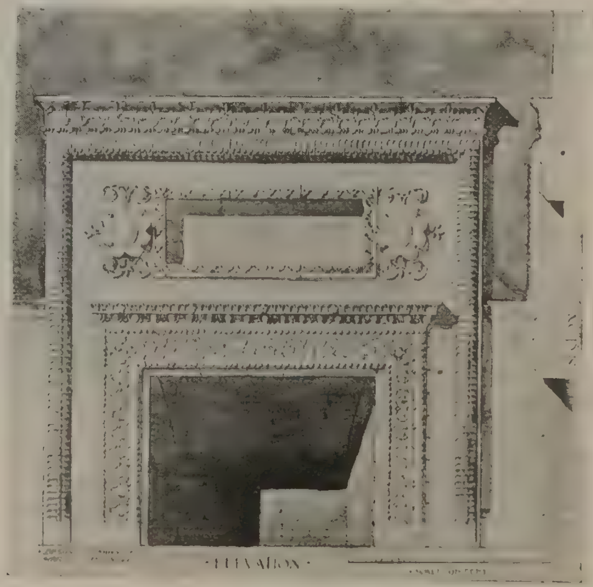
ON one thing all are agreed. It is that some of the most artistic effects are obtained by the use of brick and terra-cotta in the construction of fireplaces and mantels.

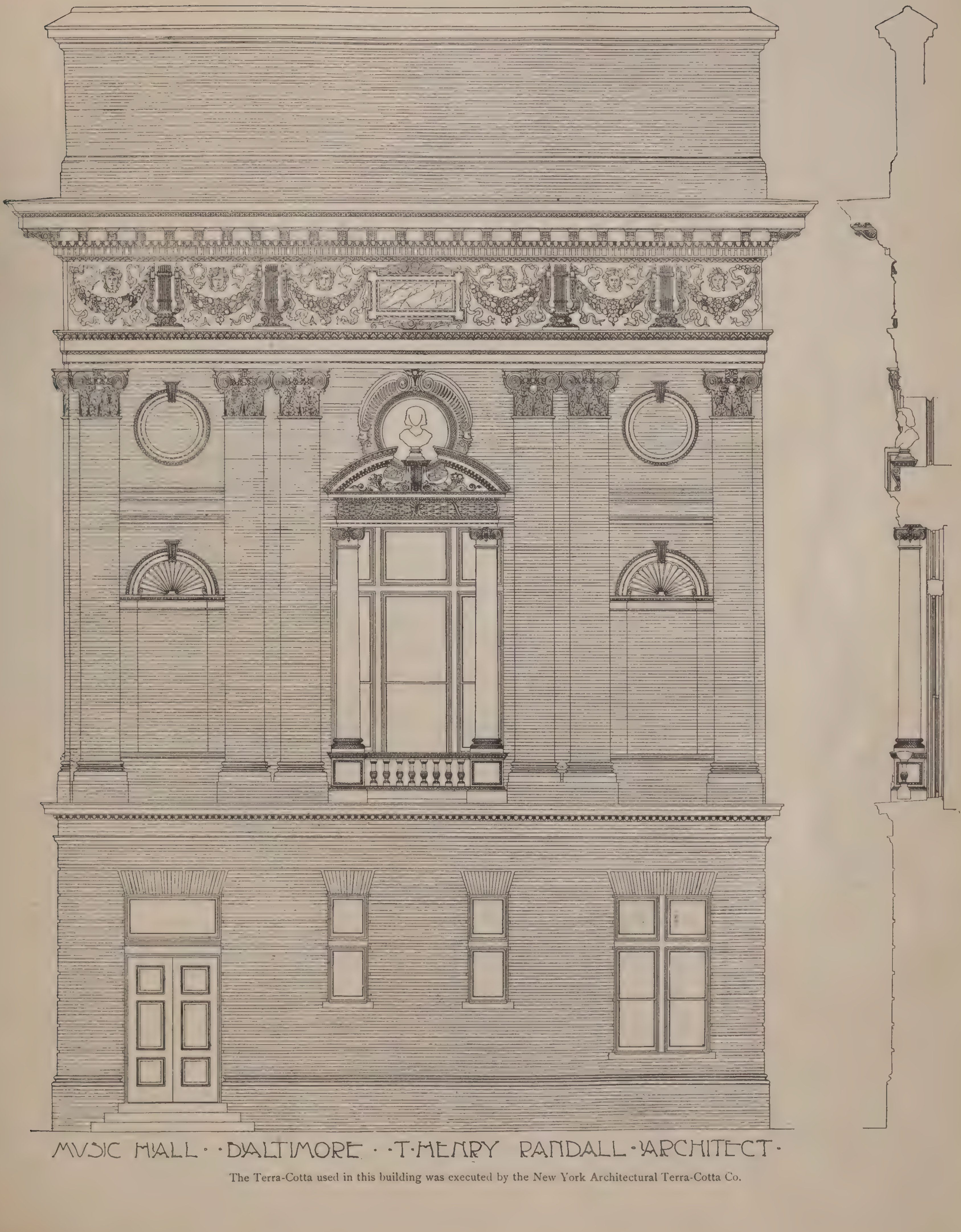


In the selection of brick for such work only first-class material should be used, otherwise there is likely to be serious trouble from the bricks chipping. We know of instances of this kind where as a result of the use of soft brick it has been necessary to tear out and rebuild fireplaces.



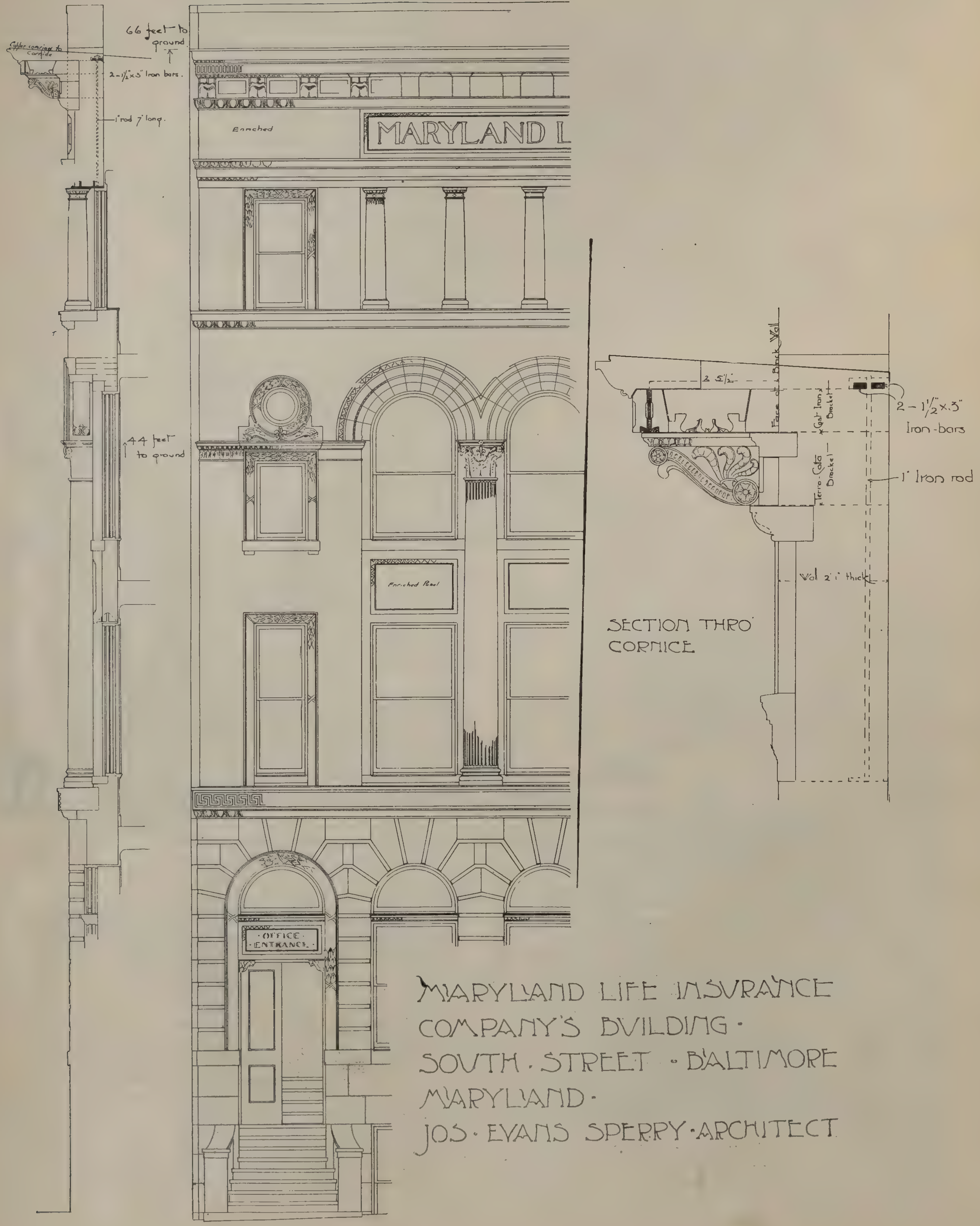
By permission of Messrs Fiske, Homes & Co. we have selected from their new catalogue entitled "Open Hearth" three designs for brick fireplaces and mantels, illustrations of which we publish herewith.



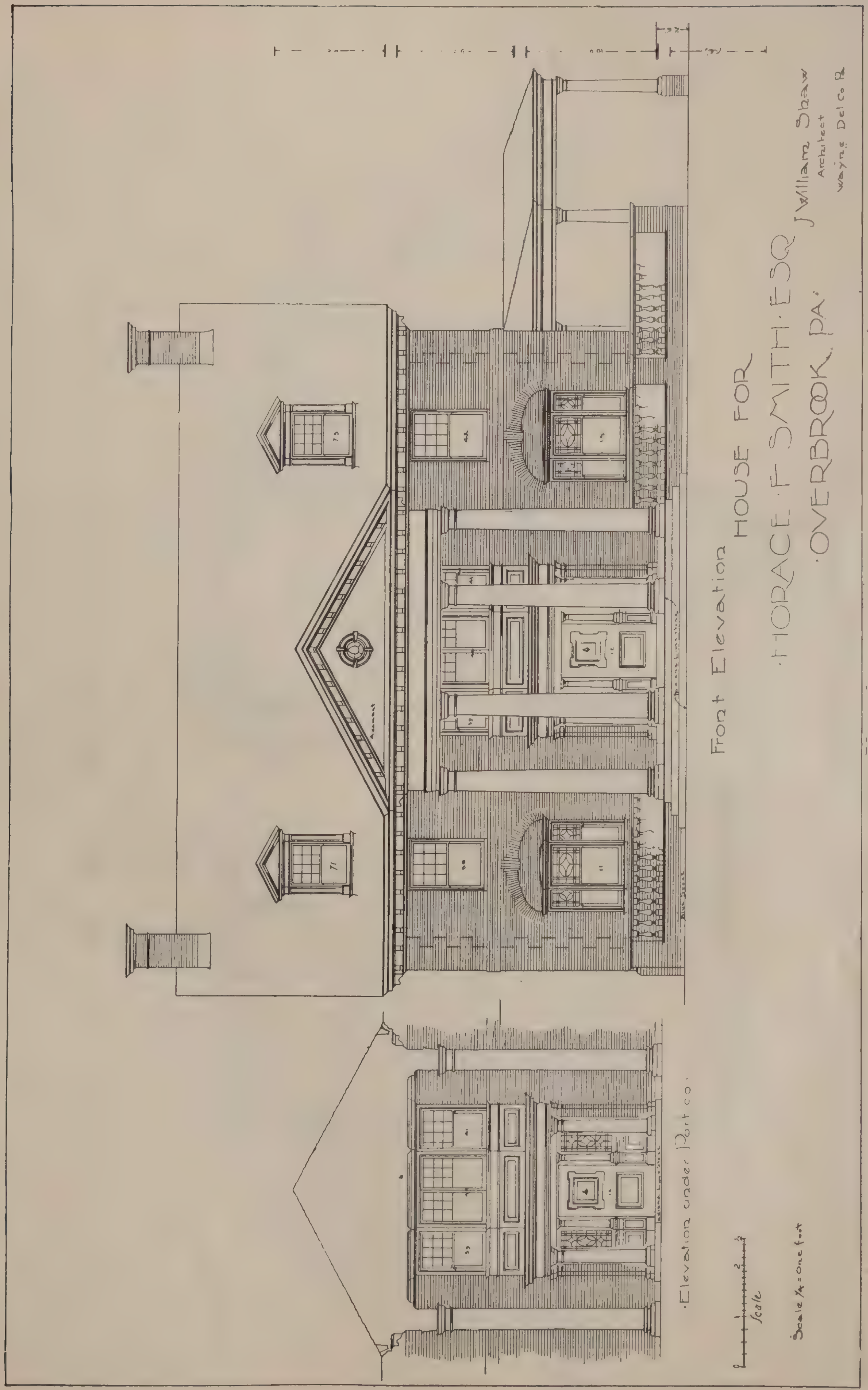


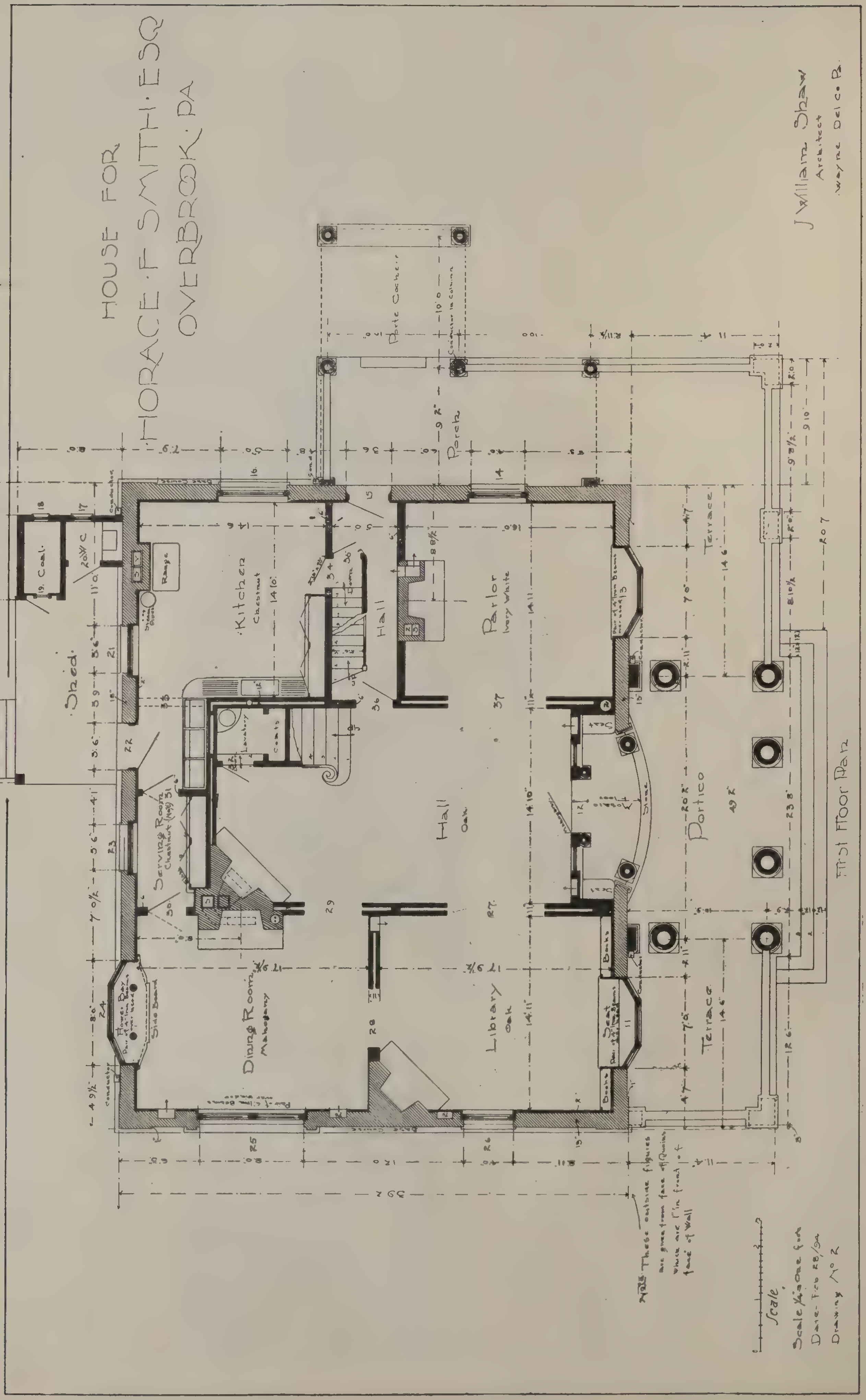
MUSIC HALL · · BALTIMORE · · T·HENRY RANDALL·ARCHITECT·

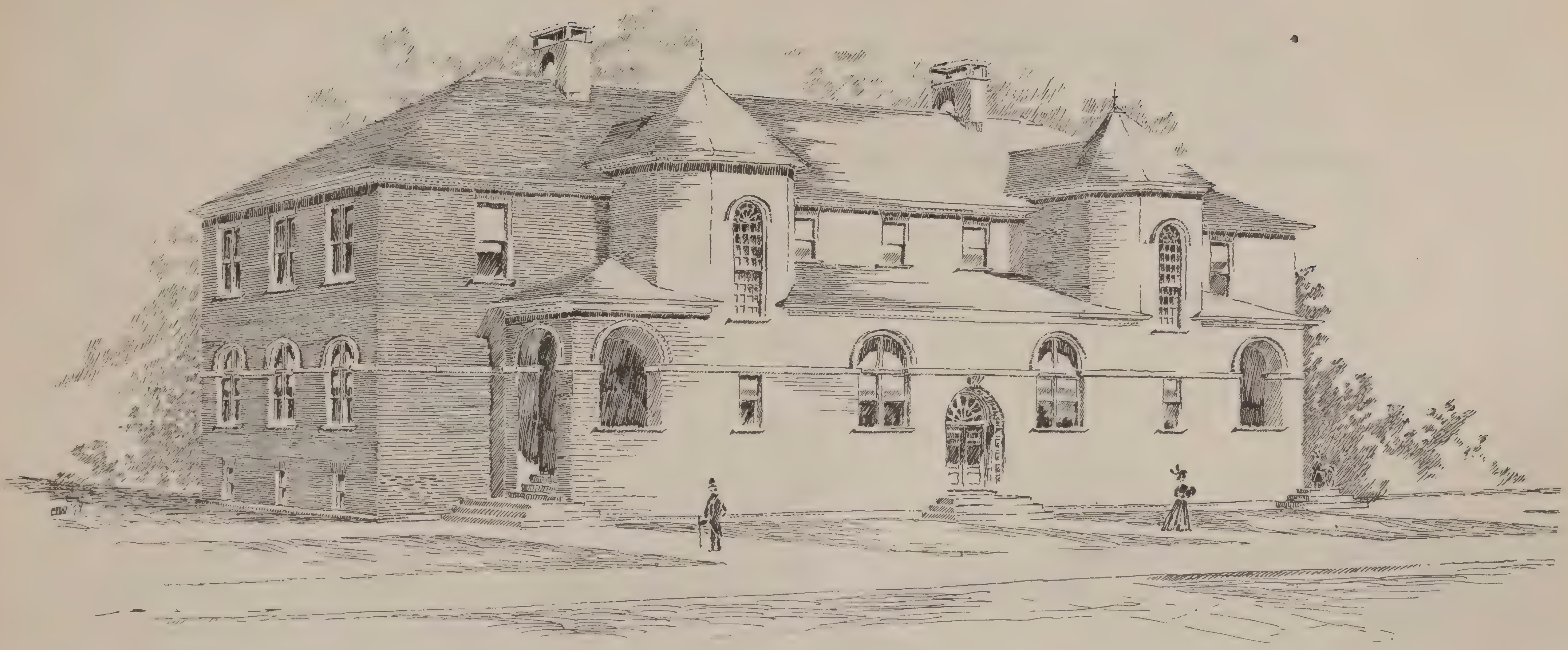
The Terra-Cotta used in this building was executed by the New York Architectural Terra-Cotta Co.



MARYLAND LIFE INSURANCE
COMPANY'S BUILDING ·
SOUTH · STREET · BALTIMORE
MARYLAND ·
JOS · EVANS SPERRY · ARCHITECT


Front Elevation
HOUSE FOR
·HORACE·F·SMITH·ESQ
·OVERBROOK, PA·
J William Shaw
Architect
Wayne Del Co Pa
·Elevation under Portico
Scale
Scale 1/4 = One foot

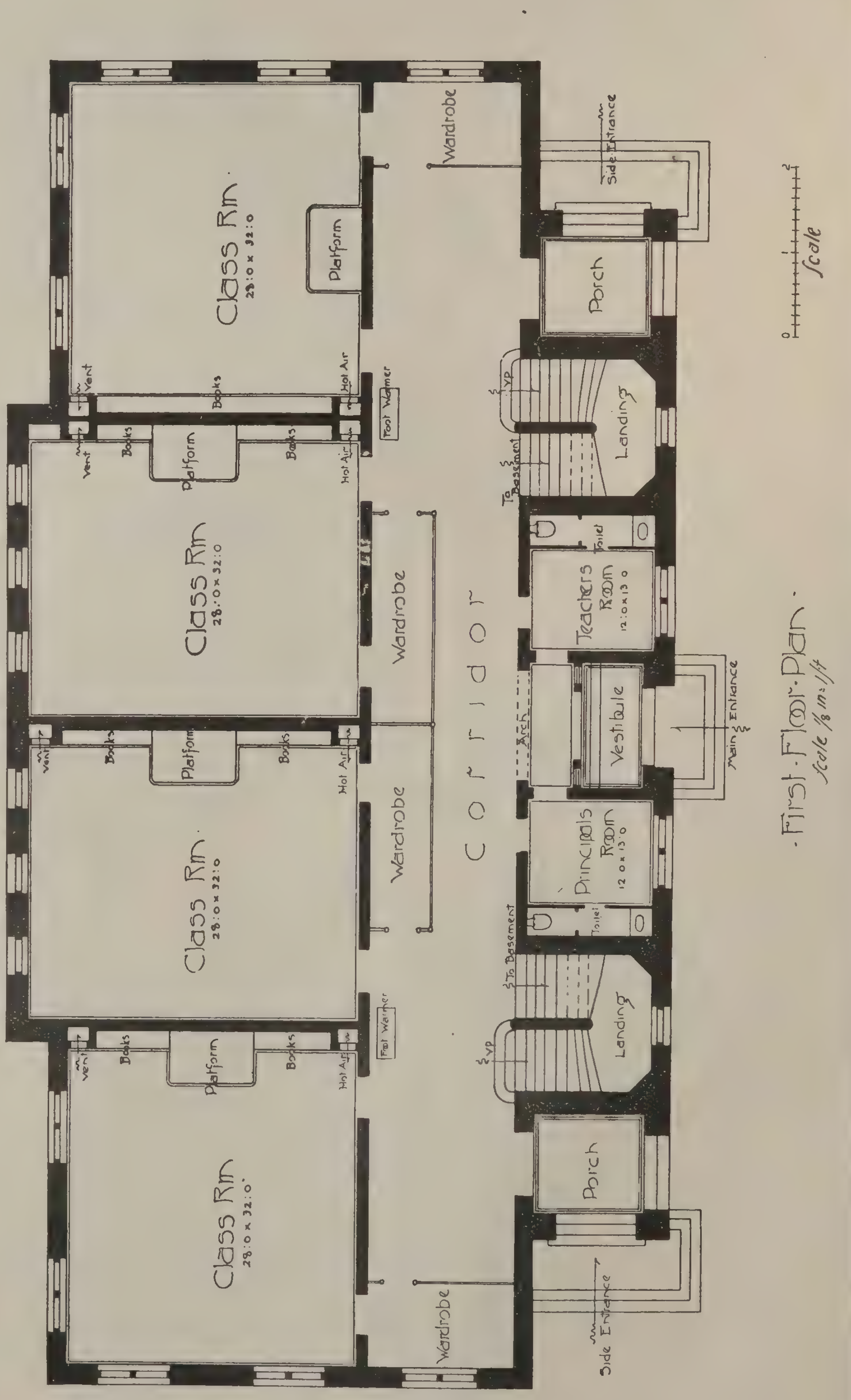

HOUSE FOR
HORACE · F · SMITH · ESQ
OVERBROOK · PA
J William Shaw
Architect
Wayne Delco Pa
First Floor Plan
Porte Cochere
Porch
Terrace
Portico
Shed
Coal
W C
Kitchen
Chestnut
Range
Hall
Parlor
Ivory White
Hall
Oak
Coats
Lavatory
Serving Room
Chestnut
Dining Room
Mahogany
Flower Bay
Side Board
Library
Oak
Seat
Books
Note. These outside figures are given from face of Quoins which are 1" in front of face of Wall
Scale
Scale ¼ = one foot
Date Feb 28/94
Drawing No 2



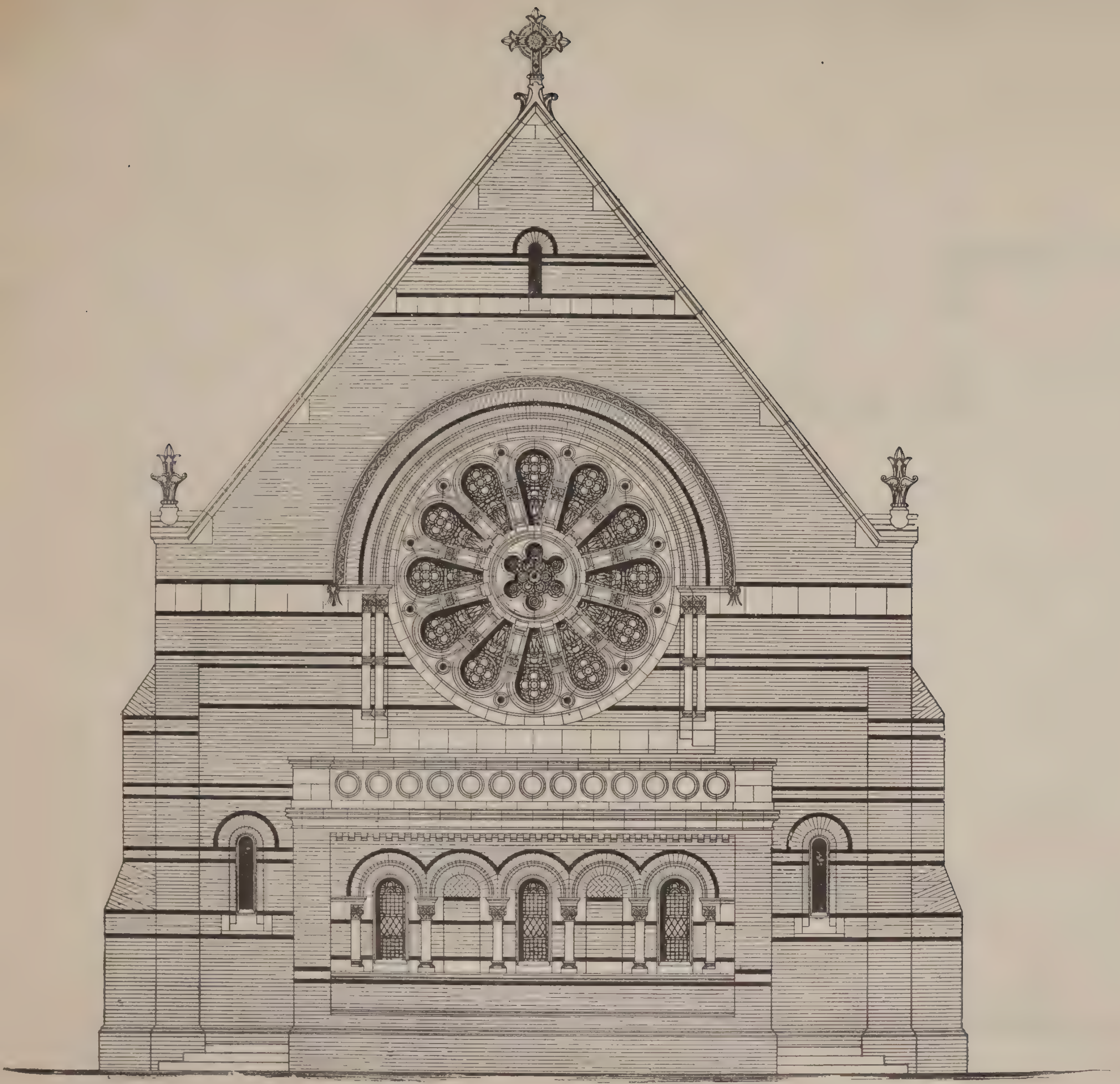
GRADE SCHOOL, NEW BEDFORD, MASS.
Edward A. Wilson, S. Adams Webber, Architects, Boston.

·GRADE·SCHOOL·NEW·BEDFORD·MASS·

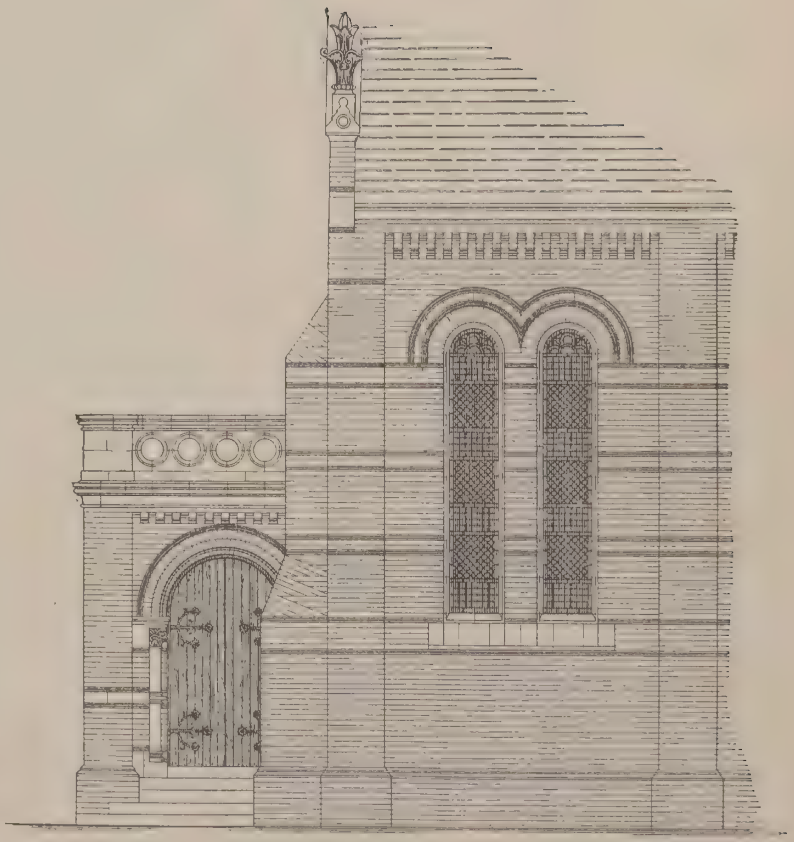
·EDW·I·WILSON·ARCHITECTS·
S·ADAMS·WEBBER·92·MASON·BLDG·
·BOSTON·



·First·Floor·Plan·
Scale 1/8 in.=1 ft



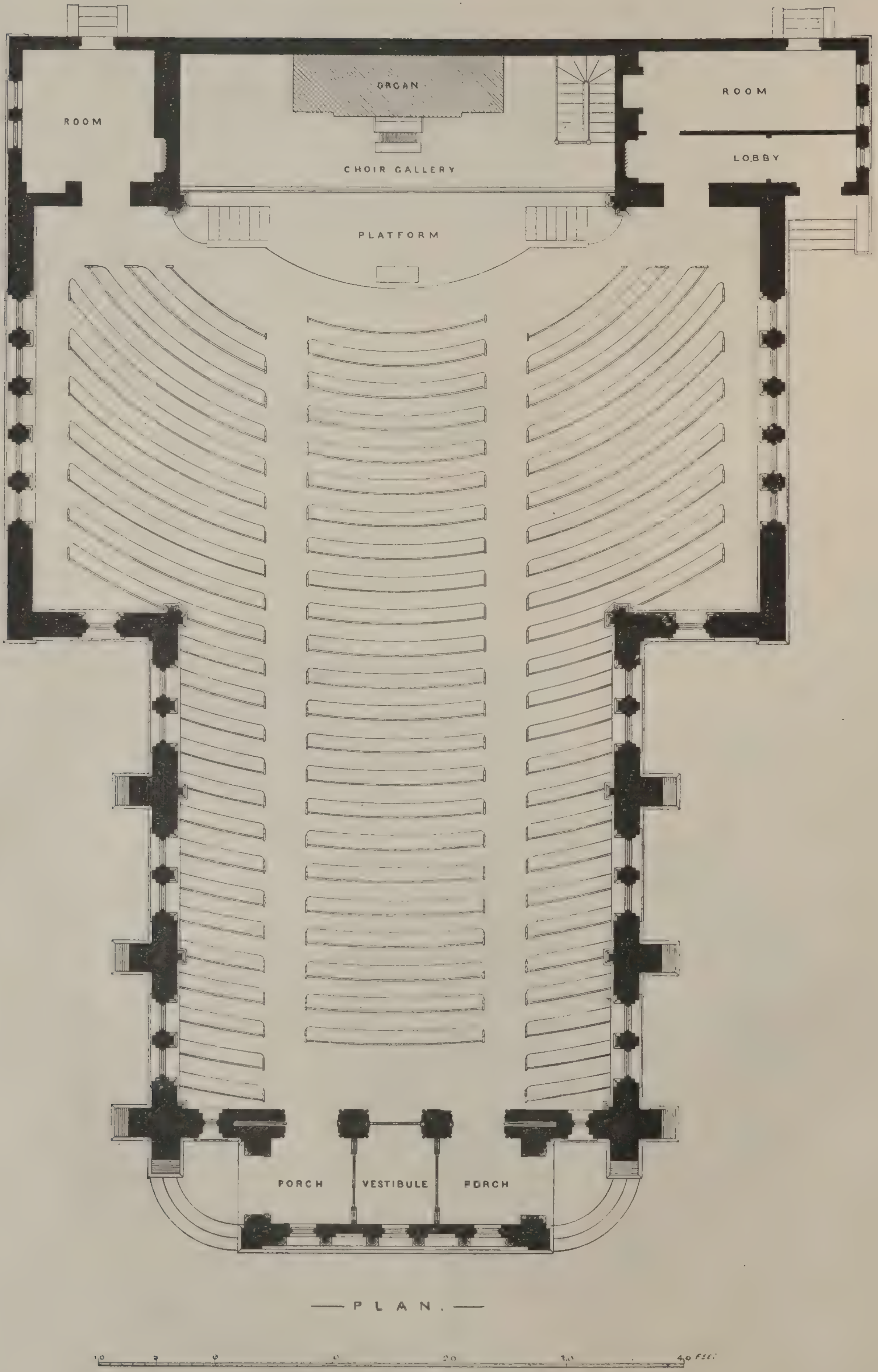
FRONT ELEVATION.



SOUTHWEST ANGLE OF NAVE.

FOURTH PRESBYTERIAN CHURCH, INDIANAPOLIS, IND.

W. and G. Audsley, Architects, New York.



FOURTH PRESBYTERIAN CHURCH, INDIANAPOLIS, IND.

W. AND G. AUDSLEY, ARCHITECTS, NEW YORK.

THE BRICKBUILDER.

AN ILLUSTRATED MONTHLY DEVOTED TO THE ADVANCEMENT OF ARCHITECTURE IN MATERIALS OF CLAY.

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PUBLISHERS' STATEMENT.

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WE think it may be worth while to call the especial attention of some of our readers to the translation, now appearing in our pages, of Choisy's well-known work on "The Art of Building among the Romans," which has hitherto been accessible only in the original French. We undertook this translation, not merely because of the great interest and value of the work as an essential to the proper understanding of Roman architecture, but because we felt convinced that it was full of suggestions of the greatest practical value. We commend its perusal, therefore, not only to the architect interested in an important branch of the history of his art, but to the practical man on the lookout for new and improved methods of construction. We say "new," meaning "new to us," for it will be found that many of the devices which we speak of as "new," and fondly regard as inventions of this ingenious nineteenth century, have been anticipated by the Romans or other ancient peoples. Many of the methods of vaulting used by the Romans, and so clearly described by Choisy, are applicable to our modern fireproof buildings. A modification of one of these old Roman methods, the so-called Guastavino vaulting, was introduced here a few years ago by Signor Guastavino, from Spain, where it is a traditional method of work, dating back in origin undoubtedly to the time of the Romans. We refer to the well-known success of this method as a signal example of good practical results from the adoption of a Roman method. We believe that a further study of the methods of Roman construction, as elucidated by M. Choisy, would prove fruitful of like excellent results. The best and most permanent use of brick is, undoubtedly, to be found in connection with such a system of concrete construction as the Romans employed.

A SPLENDID recent example of the application of Roman methods to modern work is to be found in the construction of the new Congressional library at Washington. Comparatively little iron enters into the construction of the building, and almost every form of Roman vault is to be found here. When, however, the method of vaulting is examined in detail, it is found to follow modern rather than Roman methods. We believe that a still closer following of Roman methods would have been an economy in the work. In the Congressional library continuous centerings have everywhere been employed, whereas the Roman method employs a skeleton of masonry ribs or arches, which form, as it were, a permanent centering for the support of the brick and concrete vaulting, thus greatly reducing the amount of wooden centering required. The enormous strength of this method of construction is attested by the numerous Roman ruins, even vaults that have fallen by the destruction of the walls often retaining their shape. By the use of the Roman method, iron can be dispensed with altogether, when the buildings are not of exaggerated height, and we believe this omission increases the chance of permanent stability.

THIS revival of some of the excellent methods and building materials of earlier ages is one of the encouraging signs of the times, and has been nowhere more marked than in the revival of the manufacture of terra-cotta, both structural and ornamental. Structural terra-cotta, employed in our modern buildings, especially those used in connection with iron, is essentially modern, but our use of ornamental terra-cotta is but a revival of earlier methods, mainly those of the Renaissance architecture of North Italy, but which date back to the Romans and the Greeks, the Persians and the Assyrians. Our method of enclosing iron beams in terra-cotta casings is not unlike that employed by the Greeks for encasing wooden beams. As a rule, our casings are, in turn, covered over with plaster, but we might well take a hint from the Greek builders of Sicily, five or six hundred years before Christ, and make these terra-cotta casings themselves ornamental. Much is to be learned from the study of these Greek terra-cottas, used in the structure and decoration of buildings. The making of such a finial or akroterion, as that of the temple of Hera, at Olympia, a great plaque, over seven feet in diameter, and richly decorated, which dates back to the eighth century before Christ, is a feat our best terra-cotta manufacturers would be proud of to-day, and no colored faience or terra-cotta has been made which can compare in either beauty or brilliance with the great frieze of the archers which decorated the palace of the Persian monarchs at Susa. We mention these things to emphasize the advantage of studying the best work of elder days. Our terra-cotta manufacturers have made great strides, and the recent rediscovery of methods of producing glazed colors which will stand the weather, opens up "fresh fields and pastures new" to the designer. A careful and loving study of the splendid work that has been done in similar materials in the past will help us to make the best use of these resources, still so new to us, and stimulate to further progress.

The increasing use of a method of construction which is essentially an iron frame, encased in terra-cotta, ought to lead to a consistent development of decorative forms in terra-cotta in harmony with the new method of construction, and in this new development we believe that colored faience is sure to play an important part. In France especially some not altogether unsuccessful attempts in this direction have recently been made, which ought to be helpful in our endeavors to apply these old methods to new conditions. In our high buildings especially, the use of traditional architectural forms, which are the outgrowth of what might almost be referred to as the opposite method, the method of construction in courses, do not seem to be quite in place. As yet the method of construction itself may be said to be on trial, and there are not wanting, as the discussion at the last meeting of the A. I. A., in New York, showed, architects of the greatest experience who condemn it altogether.

NOTHING more foolish, we think, has ever been done in the name of organized labor than the passage of the recent law by the Legislature of the State of New York, obliging all dressing of stone, used for city work, to be done by American citizens. It was supposed at first that the law would apply only to stone used for buildings. It now appears, however, that it is applicable also to stone used for paving purposes, and it has been hinted that the law was passed, not in the interests of native "labor," but in the interests of paving companies who are rivals of the stone pavers. Our legislative methods are dark and mysterious, but the law on its face looks more like a foolish move of "labor" than a shrewd move of "capital." That its effect will be to increase the demand for brick and terra-cotta we can hardly doubt, but no one yet has had the temerity to accuse the brick and terra-cotta manufacturers of fathering the measure.

Fireproofing Department.

Conducted in the Interests of Building Construction to Prevent Loss by Fire.

FIREPROOF FLOOR ARCHES.

(*Continued.*)

BY GEORGE HILL, C. E.

PUBLISHED TESTS. — CONTINUED.

St. Louis Tests. (*Engineering Record*, May 7, 1892.) These were tests made by Messrs. Johnson & Flad of concrete floor arches in the Wainwright Building. The arches were of various spans, but those tested were about 8′, with a depth at the abutments of 15″, a rise of about 12″, and a thickness at the crown of 2⅛″, and were true segmental arches. The load was applied by bolting heavy wooden beams over the arch and between the arch and the beam, placing a bag under them, one side of which was of sheet iron and the other of rubber, and filling the space between with water under pressure. (See Fig. 10.) The static tests were made as follows: —

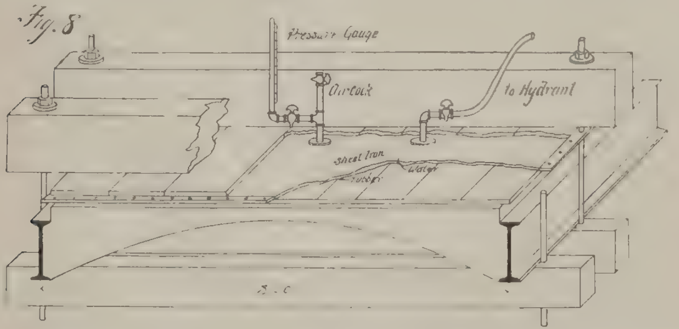


Fig. 8

Uniform Load. (33.) The arch was composed of four parts by volume of breeze to one part of Acme cement, and the arch was about two months old when tested. It was 8′ span, 4′ 11″ width, 2⅛″ deep at the centre, 15″ at the abutments, and was built between 12″ I beams, the top of the arch projecting 3″ above the top of the beams. The beams were provided with two 1¼″ round rods connecting the bottom flanges, one at each end of the section tested. The load was applied to a surface 7′ 4″ x 4′. The arch broke at the centre along a line parallel with the I beams with 16,400 pounds, corresponding to 559 pounds per square foot.

Uniform Load. (34.) The arch was composed of four parts by volume of breeze to one part of Alsen Portland cement for a depth of 3′ measured up from the surface of the intrados; the balance was composed of eight parts of breeze to one part of the same cement. The arch was about two months old when tested; the span was 8′, the width 4′ 4″, depth at centre 3″, depth at abutments 15″. The skew-back beams were of 12″ beams riveted to the supporting girder 15′ from end of the test arch at one end, and the other end was secured by a 1¼″ tie rod passing through the centre of the web at the centre of the width of the arch, and a 1¼″ tie rod connecting the bottom flanges at the end of the arch. The load was applied to a surface 7′ 4″ by 4′. The arch broke at the centre as before with a total load of 39,360 pounds, or about 1,340 pounds per square foot, and carried this load when the deflection at the centre was 1¼″.

Eccentric Load. (35.) The arch was constructed of four parts by volume of breeze to one part of Alsen Portland cement, and was somewhat more than two months old when tested. It was of 8′ span, 4′ 7½″ wide, between 2⅛″ and 2¾″ deep at the centre, 15″ deep at the abutments, and was built between one 15″ and one 12″ beam, the top of the arch being flush with the top of the 15″ beam. The beams were held from spreading by means of a 1¼″ rod passing through the web of the beams and two 1¼″ rods connecting the bottom flanges of the beams, one at each end of the section tested. The load was placed on the half of the arch next the 15″ beam on an area of 4′ long by 3′ 11″ wide. The arch broke along two lines parallel to the beams, one at the centre and the other 2′ therefrom, and under the loaded area, under a load of 12,027 pounds, equivalent to 768 pounds per square foot of the loaded surface.

No statement is made as to what the deflections were, as to whether or not there was any spreading of the beams, as to whether or not the arch failed by compression, nor as to the weight per superficial foot of floor area. From tests which will be subsequently given, I should judge that the failure was probably due to an elongation of the tie rods, or else that breeze is a very poor material to use, as the absolute strength of the arches was rather low for concrete of a good character.

Austrian Tests. (36.) (*Engineering News*, Aug. 24, 1893.) Communicated by F. E. Von Emperger.

Kind of Arch.	Span.	Rise.	Thickness.	Breaking Load.
Brick.	13.3	15 3-4	6 inches.	321.5
Concrete.	13.3	15 3-4	4 inches.	737.3
Monier.	13.3	15 3-4	2 3-8 inches.	839.7
Melan.	13.3	11	3 1-8 inches.	3,360.0

In the above the span is given in feet, rise and thickness in inches, and the breaking load in pounds per square foot. The Monier arch was built of concrete, with iron rods on the intrados. The Melan arch was built with three and one eighth inch I beams of steel, the concrete mixed one to five, and the general form of erection was as shown in Fig. 10. In order to secure a proper concentration of the load a wooden frame, enclosing an area of ten square feet with a funnel-shaped central portion, was constructed, and this was filled with gravel and loaded on the top. The centre of the frame was placed immediately over one of the steel ribs, which were spaced three and three tenths feet apart. There were four of these ribs placed in line, and the loading was concentrated over one of the central ones.

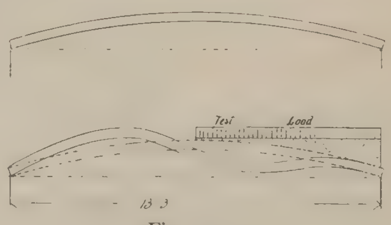


Fig. 10.

The arches failed first at a point immediately under the centre of gravity of the load, or at the corresponding point opposite it where the tension was a maximum. The Melan arch, when it failed, simply crushed down the one beam, leaving the other beam on either side intact. No information is given as to the amount of deflection, nor as to the character of the collapse when it finally occurred.

Porous Terra-Cotta Tests. (37.) (*Engineering Record*, April 14, 1894.) Staten Island Terra-Cotta Lumber Company. These were tests made of full sized porous terra-cotta lumber segmental arches. The arches were of nearly 15′ 4″ in span with a rise of 16″, and were made of two sizes of blocks which were nearly rectangular in cross section and 12″ long in a direction parallel to the skew-back beams, and were respectively 6″ deep for a width of 7′ 8″ across the centre section and 8″ deep for the balance. Shores were placed under the skew-back beams in order to support the beams under the heavy concentration of load. The haunches of the arch were covered with concrete which was so green that the wooden nailing strips were forced down into it so that the platform upon which the brick was piled was forced down, giving a bearing over the entire area of the concrete. The bricks used for loading were computed to weigh 85 pounds per cubic foot.

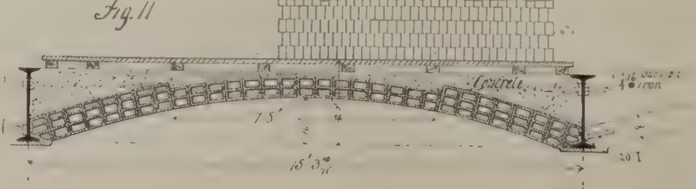


Fig. 11

The first test was made as shown in Fig. 11, and a load of 34,000 pounds was imposed on an area of about 34 square feet. As no signs of failure were observable, a block of granite 2' x 2' x 3' weighing 2,000 pounds was rolled over and over on the arch from the right-hand beam to the left-hand beam. After this test had been applied, a barrel of cement weighing 315 pounds was dropped endwise from a height of 12 feet, so as to strike near the point of junction between the 8'' and 6'' blocks. The load was then increased to a total of 42,500 pounds. At this point the unloaded side of the arch buckled and rose at the haunches, and the loaded side began to settle; the joints opened, and in thirty minutes the arch collapsed. A length of ten feet or two panels, that subjected to the load and the adjacent one which had been subjected to the impact test, went out.

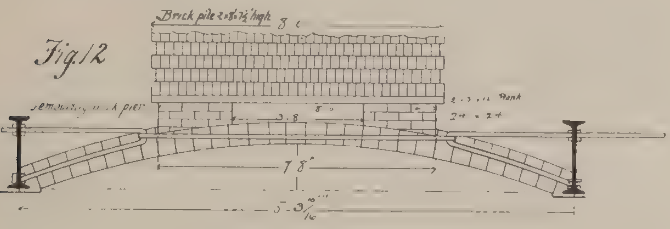
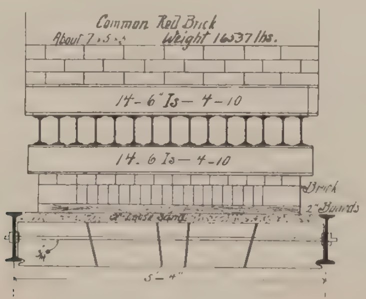


Fig 12

A second test was made with a load as shown in Fig. 12. In this case the concrete was omitted, and two brick piers, each two feet square, were built up on the arch and were used to support a platform upon which 10,300 pounds of brick were piled. This produced a load of 1,275 pounds per square foot of bearing surface, and gave no signs of failure after having been successfully carried for several hours. It will be observed that in one case the test was carried to destruction, and in the other the verdict was a Scotch one. It will also be observed that the method of placing the tie rods was such as to give but little practical result, and, as a consequence, the full strength of the arch could not be developed. It is also worthy of note that the arch failed in a manner very similar to the failure shown in Fig. 10 under a similar eccentric manner of loading. What the result would have been had the concrete used in Fig. 11 been thoroughly set is of course a mere matter of speculation.

Porous Terra-Cotta Test End Construction. (38.) (*Engineering Record*, Nov. 17, 1894.) Staten Island Terra-Cotta Lumber Company. This was a test of 9'' porous terra-cotta lumber end construction arches put in with flange protecting skew backs between 10'' beams, and the effective working depth was about 7'' for a span of 5' 4''. The tie rods were placed about 5' 3'' apart on centres, thus separating the arches into sections of about twenty-eight square feet of area. The imposition of the load was similar to that shown in Fig. 13, there being first loose sand, then planking, then bricks, then I beams of varying sizes, and then a large pile of bricks. The deflection was measured by means of a multiplying device, which multiplied the deflection nine times. The loaded area was 20.25 square feet, and on this a load of 21,846 pounds was imposed. The arch was laid up in a mortar composed of one part of domestic cement, one part lime, and three parts sand, and the arches were forty-eight hours old when tested. The static load produced no effect which was visible. An impact test of the usual character was made immediately after the static test, and while the static load remained on the arch. This gave a very slight permanent set, but did not destroy the arch. It will be observed that in the static test care was taken to secure what was practically a uniform distribution of the load, and that the skew backs sustained a shear of 2,400 pounds per lineal foot. Further particulars of tests of this form of arch will be given later.

Fig 13



Henry Maurer & Son. (39.) (Catalogue.) Test made at works of an end pressure hard tile arch similar to Fig. 6 in cross section, but with an additional central web, and with a better form of skew back. This arch was made with a span of 8' and of a length along the skew-back beam of 5', and the entire area of the arch was loaded with a pile of brick which weighed approximately 50,000 pounds. This arch was made of blocks 8'' deep, which projected below the bottom flange of the beams so as to reduce the effective depth about 1½'. This load produced no deflection or other visible effect upon the arch, and has been sustained for about one year. Further particulars of tests of this form of arch will be given later on, but it is particularly worthy of note that 5,000 pounds per lineal foot of skew back is being sucessfully carried.

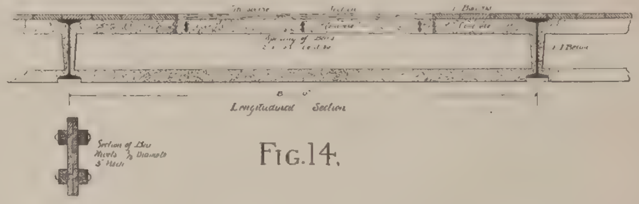


FIG. 14.

Columbia Fire Proofing Company. (40.) (Catalogue.) These arches are built of a combination of concrete and iron as shown on Fig. 14. Tests were made for the patentees by Messrs Ferris, Kaufman & Co. as follows: Slabs of concrete and iron about 3'' thick were built between two 12'' I beams with the top of the slab flush with the top of the I beam; the beams were about 8' on centres, and the slabs were 6' long parallel with the beams. The steel bars were placed about 2' apart on centres, and over the top of the bars chicken netting of 2'' meshes was laid. The concrete was composed of one part Alsen cement, two parts of sand, and three parts of Ligonier screenings. One slab was tested when nine days old by covering the slab with 1'' boards placed parallel with the beams and loading with pig iron. A load of 89 pounds per square foot gave no deflection, 200 pounds per square foot gave a deflection of ¼'', sufficiently great to destroy the future usefulness of the floor. Four hundred pounds per square foot gave a deflection of 2'', while 578 pounds per square foot gave a deflection of 5''. This slab was weakened probably by a premature loading two days before of 200 pounds per square foot, which left the slab with a permanent deflection of ⅛''. A second slab built in a similar manner but of lighter material was tested when thirteen days old by the imposition of a load of 310 pounds per square foot, giving a deflection of ½'' for a span of 6'. A third slab with a span of 8' with somewhat heavier bars was tested by means of a lever, with a load applied on a space along the centre line of the slab, covering a length of 6' and a width of 5''. A centrally applied load of 4,867 pounds caused a deflection of ⅕'', which upon its falling accidentally caused a permanent set. It is quite evident that a depth of 3'' for a span of 8' is such as to lead to an excessive deflection for a moderare fibre strain or a waste of material.

It is also evident from the above that the strength of the construction is largely dependent upon the honesty of the workmanship in putting in the best possible material, and that there is no comparison in strength between this method of floor construction and some of those previously given; while it contains fundamental errors in that it uses an uneconomical section of metal for the steel stiffening members, and insufficient depth to secure rigidity of the floor, which is a prime requisite, has a ceiling construction so light as to be certain to sooner or later sag between the supporting beams, and is dependent entirely on the honesty of the workmen for much of the strength it possesses.

While there are cases where its use would be both wise and economical, it is doubtful if it is of general applicability.

(*To be continued.*)

Mortars and Concrete Department.

Devoted to Advanced Methods of using Cements and Limes in Building Construction.

AMERICAN CEMENT.

III. — *Continued.*

IN the year 1818, twenty-two years after Parker had patented his Roman cement, Canvass White of this country discovered and patented a similar cement found at or near Fayetteville, N. Y.

This cement was used in large quantities in the construction of locks, viaducts, and culverts on the Erie Canal, at that time in the course of construction. Subsequently the State of New York purchased the patent from Mr. White, paying him therefor the sum of $10,000, and made the discovery public property.

In 1824, the year in which Aspdin obtained a patent on his artificial Portland cement, natural cement rock was discovered at Williamsville, Erie County, N. Y., where a manufactory was established. This cement was used extensively in the construction of the locks on the Erie Canal at Lockport, N. Y.

In 1826 natural rock cement was produced at Kensington, Conn., and was continued for several years, the production amounting to about five hundred tons yearly. On account of unfavorable transportation facilities, the production ceased soon after the cements manufactured on the Hudson River were placed in the larger markets.

In 1828 a cement works was established at Rosendale, Ulster County, N. Y. The product of the factory was first used in the construction of the Delaware and Hudson Canal, then being built through the town of Rosendale.

Other cement works soon followed at this place. Owing to the general good quality of the cement rock, and its proximity to New York City, as well as the advantages afforded by cheap transportation on the Hudson River, this locality rapidly developed into the leading natural rock cement centre of this country, a position it maintains to the present day. Its yearly production amounts to about two and three fourths million barrels.

In the year 1829 cement rock was discovered at Louisville, Ky., while excavations were being made for the Louisville and Portland Canal, and it was manufactured and used during that year in the canal walls and locks.

Here again the rock proved to be of excellent quality. This fact, taken in connection with the conveniences in the matter of transportation on the Ohio River, and the advantages resulting from a wide and uncontested field of trade, led to the rapid introduction of this cement, and made the locality the centre of the cement industry beyond the Alleghenies, and in some seasons the production has been as great as 1¾ millions barrels, and is exceeded only by the production from the Rosendale district.

During the summer of 1831 excavations were made for a canal on the left bank of the Susquehanna River to connect Muncy and Lock Haven, Penn., at a point about ten miles west of Williamsport on land known then and now as "King's Farm." The excavations disclosed an enormous body of rock, which was ascertained by Mr. Robert Farries, chief engineer of the canal, to be hydraulic cement rock. Col. George Crane, a prominent man of his time, living in a stately brick mansion across the river directly opposite "King's Farm," was a contractor on the canal at the time, and he at once set about constructing a cement works for the manufacture of cement from this deposit for use in the construction of the canal. He built five kilns with suitable facilities for grinding, and his cement was used in the construction of the locks, bridges, culverts, dams, and viaducts, the latter in some places being over three hundred feet in length.

When the canal was finished in 1834, the manufacture of the cement was discontinued, but the condition of the work, done over sixty years ago, with the product of this somewhat primitive plant, gives promise to-day that the rocks themselves will endure no longer than the material which binds them together.

In 1836 the Cumberland Hydraulic Cement and Manufacturing Company established a natural rock cement works at Cumberland, Md., which has since been in continuous and successful operation. As a result of the excellent quality of this rock, other works were subsequently erected, and the yearly output has been large, and the Cumberland cement bears a most excellent reputation.

In 1837 cement rock was discovered at Round Top on the left bank of the Potomac River, near Hancock, Md., by A. B. McFarlan, a contractor of Washington, D. C., and the following year he manufactured cement from this rock, and used it in the construction of the Chesapeake and Ohio Canal. The graceful viaducts along the line of this canal, with the mortar unimpaired, attest the enduring qualities of Round Top cement.

It was during 1838 that cement rock was discovered at Utica, Ill., and works were erected during that year by Norton & Steele to supply cement for the construction of the locks, culverts, and bridges of the Illinois and Michigan Canal, and the rock proving to be of most excellent quality, the manufacture since that time has been uninterrupted.

In 1845 this plant passed into the possession of Mr. James Clark of Utica, Ill., and has been operated by him until 1888, at which time it was incorporated as the Utica Hydraulic Cement Company, and its capacity largely increased. This cement has always stood well in public favor. In the masonry laid with it over fifty-five years ago, the joints are as hard to-day as the stone itself.

In 1839 natural rock cement was first produced at Akron, N. Y. The rock proving of exceptionally fine quality, its manufacture has been continuous, and steadily increasing in volume. Some of the most important engineering works of the country have been constructed with it, and its enduring character is well established.

In 1848 cement works were established at Balcony Falls, Va., by O. H. Locher; the works are known as the James River Cement Works. O. H. Locher & Co. are still the proprietors at Holcomb's Rock, Va. The cement from these works has always borne an excellent reputation.

In 1850 cement rock was found at Siegfried's Bridge in the Lehigh Valley, Penn., and cement was produced and used in the construction of the Lehigh Coal and Navigation Company Canal from Easton to Mauch Chunk. Its manufacture has been continuous, and has assumed large proportions, with a constantly increasing demand.

In 1850 cement rock was discovered at Cement, Ga., by Rev. Chas. W. Howard of Charleston, S. C, and the eminent chemist, St. Julien Ravenel, also of Charleston (and a personal friend of Prof. Agassiz), who analyzed the rock, found it to be of a high quality; and its manufacture was commenced by Mr. Howard and his son in the following year, and was prosecuted by them until the beginning of the late war, when they both volunteered in the Confederate service, and the cement factory was allowed to fall into disuse.

In 1867 Col. George H. Waring, then of Savannah, Ga., purchased the property, and again the plant was put in running condition, and has since been operated continuously as the Howard Hydraulic Cement Company, Geo. H. Waring, president.

The cement manufactured by this company probably has no superior in this or any other country. Used as an exterior plaster in 1852 by Dr. Ravenel on his house in Charleston, situated on the Battery, where the walls are exposed to the disintegrating influences of salt spray, the stucco still remains unimpaired, while the sandstone lintels of the windows have long since been worn away.

In 1867 hydraulic cement rock was first discovered at Fort Scott, Kan., and its manufacture was commenced in the following year, and since that time has been continued uninterruptedly, the works having, for several years, been controlled and operated by the C. A. Brockett Cement Company, of Kansas City, Mo. This company has some local advantages not enjoyed by others. An excellent vein of coal underlies the cement rock, being separated from it by a stratum of fine fire clay. This coal is used in the manufacture of the cement, which in its general characteristics greatly resembles that of Cement, Ga.

URIAH CUMMINGS.

(*To be continued.*)

ADULTERATION OF PORTLAND CEMENTS.

WHEN we hear from one of the largest English manufacturers that a number of the English Portland cement works "are largely adulterating their manufacture by the mixture of Kentish ragstone, other stone, furnace or oven ashes, disused or exhausted firebrick, or other inert material, and so bringing disrepute upon the good name of English cement," and when we learn, as was the case with some Portland cement recently received at New York from one of the Continental factories, that it was largely adulterated with ordinary river sand, we find that the European manufacturers of Portland cement are taking advantage of the lack of testing by the engineers and architects of this country, and are shipping cement here composed of sand, ashes, etc., which sell to the unsuspecting person for first-class material.

It is possible that even such a composition may be strong enough for the purpose it is used, still as it is sold as and plainly marked "Portland cement," its sale is a fraud and cheat on the American people. The engineering and architectural professions have brought this upon themselves. With pure Portland cement made at several places in the eastern part of the United States equal in every respect to the best Portland cement made in Europe (government, municipal, and private tests, covering twenty years, prove this to be a fact which cannot be successfully disputed[1]), for some American engineers and architects to specify simply "English Portland," or "German Portland," without any requirements for strength, fineness, etc., has only been an invitation to fraud, and the wonder is that it was not perpetrated long before this.

Mr. Leedham White, in his address at the meeting held in London to form an association to prevent the adulteration of English cement, says, in reference to the rule of the German Society of Cement Manufacturers, permitting the use of two per cent of adulteration in making Portland cement: "I myself am in favor of the latitude of, say, two per cent, no more, no less. I am in favor of going to the length of two per cent, because that would give sufficient latitude, as far as my knowledge goes, to the importation of a small and innocuous quantity of other ingredients which improve Portland cement in one of its several qualities." The adulteration, above referred to, is the addition of small quantities of sulphate of lime to the Portland cement, which seems to give the cement that particular quality of setting slow, (by retarding the chemical action for a short time) and hardening quickly.

Whether this is as desirable a result as it first appears, considering the nature of the adulterant, is a question now under investigation by some of our prominent chemists and manufacturers. That it is especially desirable that the quantity of sulphate of lime should be kept as small as possible in all cement to be used in sea water is a recognized fact. In Europe some of the governments permit the use of cement treated with sulphate of lime to be used in work on land and in fresh water, but for sea work the specifications are so drawn as to exclude the use of such treated cements.

Mr. Frederick H. Lewis, of the firm of Booth, Garrett & Blair, in his valuable paper on Cement Specifications, read and discussed before the Philadelphia Engineers' Club, Dec. 1, 1894, says: "As a rule, the cements which mature rapidly are treated cements, and it seems to me that this rapid hardening, producing a brittle, glass-like texture, was a disadvantage and sacrificed that valuable property of Portland cements by which they continue to gain strength and hardness through several years time."

Mr. Lewis submitted some tables showing the tests on different cements treated with different percentages of sulphate of lime. They all showed that from one to two per cent added to the cement increased its tensile strength at seven days from 25 to 60 per cent, but a larger quantity than two per cent very materially weakened the cement. Unfortunately the tests given were not carried out beyond the seven days' test. Mr. Lewis, although stating that this treating a cement with sulphate of lime made it brittle, glass-like, etc., yet further on says that it seems to him that the peculiar combination of setting slowly and hardening quickly might be a valuable one in cement mortar under some circumstances, but says: "It is entirely clear, from the tables submitted, that the addition of sulphate can be easily overdone and an amount added which will make the cement not only bad, but dangerous. Hence, I think that there is no matter of greater importance than the regulation of this sulphate. There is no doubt, in my mind, that foreign cements have been sold in this country after treatment, which could not be sold in Europe where tests and specifications are better looked after."

Now, in view of this information and the fact that all the best German cements on this market are made by members of the German Society of Cement Manufacturers, and the fact that a large percentage and, it is generally believed, all of their cements are treated with sulphate of lime, an engineer or architect using German cement on his work, which has not been thoroughly tested, has no absolute security that the cement does not contain the element of its own destruction, notwithstanding the statement in this journal several months ago, that "an engineer may be at ease when his work is being done with these standard cements."

WM. G. HARTRANFT.

PHILADADELPHIA, PA., March 1, 1895.

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[1] The writer will cheerfully furnish data on this subject to any one sending his address to 305 Girard Building, Philadelphia.

EDITOR OF THE BRICKBUILDER:

Replying to my kindly critics, Messrs. Hartranft and Sabin, I may say, in regard to the former's remarks, that I agree with him that *weight* has much to do with the quality of cement, but weight without necessary fineness is a factor rather to be feared than embraced. The product of a heavy "clinker" is enhanced in value almost in arithmetical progression, as its fineness is doubled after reaching a certain standard. A finely ground, imperfect clinker makes a better cement than a well-burned one coarsely ground, within resonable limits. It is quite true that of two samples of cement, fineness being equal, the heavier is the better product.

In important works the specification for Portland cement should embody both a fineness and a weight test; this will insure a uniformity of strength and quality, which ought to obtain in all extensive works.

These values of weight and fineness may be regulated to suit the character of work in hand, the more important commanding the higher and more costly grades.

Replying to Mr. Sabin, most English engineers and architects now adopt a "standard" for general work of one hundred and ten pounds to the "striked" imperial bushel, one thousand six hundred fine. I have before me the works of Grant, Faija, Mann, Newman, Reid, Gilmore, Thurston, Kidder, and a dozen other English and foreign authorities, besides some twenty years of "The Doings of Franklin Institute," and many papers read before the architectural and engineering societies of Great Britain, the United States and Canada, and from a fair examination of the "test" results given, to which is added my own experience, I am satisfied that for general purposes an allowance of two hundred and fifty pound is ample for the average cements, if a fair margin of safety is provided.

Of course I am aware that tests have been made showing astonishing results, some as high as twelve hundred pounds, but these are rare exceptions. I believe American manufacturers can provide a cement that will test much higher than that if necessary; they are only limited by cost.

As a matter of general usage (and good sense), cement that has once set should be discarded if strength is desired, *unless in the hands of an expert*, and Mr. Sabin evidently knows the reason why, for he hints as much.

I do not withdraw my statement anent quick-setting cements under water. Of course Mr. Sabin will understand, if the conditions are not favorable, the engineers will adopt the cement most suitable to the purpose, but I maintain a slow cement is best for submerged work, where conditions are favorable.

With regard to the expression, "the hardest burned and finest ground being the heaviest," I must confess it is somewhat "hazy." In looking over my memorandum, I find it written "best" instead of "heaviest." This would round up the sentence and be more in accordance with facts.

Yours,
FRED T. HODGSON.

COLLINGWOOD, ONT., March 11, 1895.

VARIOUS SYSTEMS OF CONCRETE CONSTRUCTION.

SO much is being said of late about concrete and its uses, that the writer proposes, in subsequent papers, to describe some methods and processes for the handling of concrete in various forms of construction.

Concrete has come to be recognized as a building material eminently suitable for foundations of all kinds, and for such works as require great strength and massiveness, and particularly for work under ground and under water.

It has come into almost universal use for massive work in dams, wharves, bridge piers, fortifications, and works of the greatest importance; no doubt whatever exists of its superiority to all other materials in this line of work.

In some places it is used out of ground and water, — in canal walls and locks, in docks and wharves, and in buildings; while in other places it has been used to displace brick and stone work in the most delicate of ornamental mouldings and ornament.

The development of concrete in its many fields has not been carried on in one locality, so that we do not find instances of the use of concrete in its fullest extent in any one place; but if we assemble the evidence, we find that there is no shadow of a doubt that concrete may displace all other building material, both in massive masonry and in ornamental work, in underground work, in exterior construction, and in any climate. In the coldest sections of this country we find concrete used in pavement work, where it must not only endure the action of weather, but also the wear and tear of constant heavy traffic in addition, and the evidence is overwhelming that no other material known endures so well. Is it not reasonable to suppose that if a piece of concrete will stand climate and wear and tear in pavements, that the same concrete will stand the climate alone, when set up in a wall? As a matter of fact, this has been conclusively demonstrated in wall construction all over the world, and in delicate ornamental work in many cities where the climate is most destructive.

Now if we assemble the evidence that may readily be gathered, the conclusion is irrefutable that concrete buildings and structures of all kinds can be built in the coldest sections of the country, and particularly in New England.

Successful work, however, depends wholly on a thorough technical knowledge of the properties of concrete, and its behavior under all conditions. This knowledge is essential for the proper design and calculation of strains in concrete structures.

Again, a thorough understanding of the manufacture of concrete is essential, and an acquaintance of existing methods, and ways, and means for handling the material in the most economical manner. This knowledge is necessary that the work may be done as cheaply as similar work in brick and stone. The writer, therefore, desires, in subsequent papers, to show how concrete may be handled, and to describe various processes by which the best results may be obtained, both by the material alone, and by using it in conjunction with other materials. Thus it may be made in such a way that it will, in appearance and strength, equal stone. | It may be united with iron in such a way as to displace steel in beams and girders.

Wall loads may be assembled on to concrete piers and buildings, built wholly of concrete, that, from an engineering point of view, are similar to the skeleton-frame buildings of Chicago.

The subsequent papers will not confine themselves to one system, but to all methods in use, which involve concrete and its uses either alone or in combination with other materials. The writer will be glad to receive descriptions or processes and methods with which he is unacquainted, with a view of presenting them on their merits and adding them to the general fund of knowledge of concrete and its uses.

It is to be understood that these papers are to be wholly impartial, and not, in any respect, to be regarded as an advertisement. Nothing will be printed which, in the writer's estimation, does not possess genuine practical value from an engineering standpoint, or add materially to our knowledge of concrete and its manufacture and use.

It is not the writer's purpose to confine himself to building construction, but to describe methods of using concrete in other structures and for other purposes, as in pipe and conduit laying, subways, tunnels, and the like.

Until comparatively recent times, concrete has been used in conjunction with other materials merely as a filling between supports or bearers. In floor construction the loads were carried by steel beams of various sections, and the concrete then arched in between, or used as slabs to fill the intervening space.

It has been shown, however, in more recent times, how perfectly the strength of steel bars, rods, chain, and netting of various kinds may be so incorporated with the concrete as to impart to it practically the whole working value of the concrete. The use of netting has been extensively used in Europe in the Monier system, and numberless works of importance — bridges, arches, and domes — have been constructed in this fashion. The use of rods with washers and other forms of hold, — Ransome, Hyatt, Jackson, — to prevent slipping, are common, and a good deal has been done with chain — Jenkins — of various kinds to give greater tenacity to masses of concrete.

One of the most clever and satisfactory methods of producing a perfect bond between concrete and iron is simply to embed square, twisted rods in the concrete in that part of the mass that is most subjected to tensile or pulling strains.

The effect of the twisting of the square bar is obviously to form a series of spirals along the bar, similar to the threads of a screw. The concrete embeds itself around the rod at every point, precisely as the thread of a screw is surrounded by the wood fibres. The result is that in order to produce a separation between the concrete and the iron there must be sufficient force exerted to shear the concrete spirals at every point, and this, within the ordinary limits of the material, is impossible. The question is asked immediately, "What effect does the twisting produce in the strength of the bar?" A long series of tests has proven conclusively that if a bar of iron is twisted cold, the iron is strengthened from fifteen to forty per cent.

The following tests, made at the University of California, are one set of a long series in which the evidence is always the same:—

TABLE I.

The tests were made on the Riehle Brothers testing machine; the iron furnished consisted of ¾ square rod, which were cut into lengths of 12 inches, with the reduced part 4 inches long and ⅝ inch in diameter, and were given ½ twist per inch (or the specimen was twisted 720°).

Generally specimens were tested immediately after twisting, but those that were submitted to the test 5 days after twisting, as suggested by Prof. Hesse, gave better results, as will be seen in the following tables.

Averaging all the results, the cold twisted, broken 5 days after twisting, gives 53.3 per cent better result than the straight specimen.

The cold twisted, broken immediately after twisting, 38.5 per cent gain, while the hot twisted shows a loss of 5.5 per cent.

TESTS MADE OCTOBER 26, 1889.

Specimens one foot long from ⅝ inches square, wrought iron.

Specimen A	Description.	Diameter.		Length.		Area in Square Inches.	Max. Load or Tensile Strength.	Tensile Strength per Square inch.
		Before Breaking.	After Breaking.	Before Breaking.	After Breaking.			
				Inches.		Inches.	Pounds.	Pounds.
1	Cold Twisted, 5 days before breaking.	.5	.493	4	4.468	.1963	13170	67193.9
2	“	.5	.495	4	4.437	.1963	13260	67653.0
3	Cold Twisted.	.5	.497	4	4.375	.1963	11920	60816.3
4	“ “	.5	.496	4	4.415	.1963	11920	60816.3
5	Hot Twisted.	.5	.467	4	4.062	.1963	8340	42551.0
6	“ “	.5	.490	4	4.625	.1963	8040	41020.4
7	Straight.	.496	.453	4	4.968	.1932	8545	44222.7
8	“	.5	.456	4	5.50	.1963	8510	43418.4

A simple method of showing the efficacy of this twisting, as regards strengthening the bar, is to take a square bar, five or six feet long, and twist half of it, the bar being cold. Break the bar in a testing machine, and it will be found that the fracture will always take place in the untwisted portion.

The application of this principle of uniting the two materials has been widely developed, and is meeting with such favor that a full account of the system will require more space than can be given at this time. In a subsequent article it is proposed to demonstrate the theory by which these two materials may be best used together, and to give an account of some of the principal applications of the principles involved.

Ross F. Tucker.

MORTAR COLORS AND MOULDY BRICKS.

IT is claimed that the Phœnicians and the early Egyptians used mortar coloring, but this is evidently without foundation. The Pyramids were erected of blocks placed upon each other without any cement, and those buildings on which cement was used were erected by the aid of hydraulic cement which turned black with age. The first record of coloring mortar is only a few centuries back, and originated in England where a red color was used, called Spanish brown. This color has been used largely in America, and its strength varies so much, and its composition is so coarse, that it is practically unfit for the purpose. Fancy coloring for mortar is really only about eleven years old. In 1884 Toch Brothers, of New York City, first imported a ferric oxide, which was nearly pure, and they sold it to several builders who wanted a permanent and uniform joint on the buildings they erected. Later a demand arose for colors other than red, and in a short time fancy colors were gotten up for this purpose, which have evidently come to stay. It is generally believed, however, that anything which contains color will do for coloring mortar, but this is a great mistake. Mortar is highly alkaline and caustic in its effect, and only a certain grade of color or a color containing a high percentage of ferric oxide will answer the purpose; and ferrous oxide, if it be one hundred per cent pure, is also absolutely unfit for mortar coloring. An organic color, no matter what its strength or price may be, is valueless for this purpose. Some builders use a Venetian red, but this is not a good color, as it contains very rarely over twenty per cent ferric oxide, the balance being calcium sulphate, commercially known as plaster of Paris. The process of the hardening of lime and sand is well known, but it is not amiss to go over this subject for further reference; the lime absorbs carbonic acid from the air and forms carbonate of lime, which is chemically the same as marble. This substance artificially will outlast a poor quality of brick; and if color be mixed with the lime which is so weak that it takes a large quantity to produce the desired shade, the bond is interfered with, and the joint is weak. Some qualities of lime contain a little free salt, and some contain a little sulphate of calcium, or plaster, due to the coal used in burning it. After a building is erected, whether mortar color has been used or not, white mouldy spots appear, sometimes on the joint, and sometimes on the brick, and so many causes have been assigned to this, that it is positively interesting to read the conjectures of the uninitiated. Many claim that it is an exudation of plaster; more claim that it is salt; and a few claim that it is chloride of calcium. It might be salt, and it might be plaster, but it is not generally either. If some of the white excrescence on a joint or on a brick be scraped together and analyzed, the spectroscope will show that it is largely composed of sodium and calcium, and a further analysis will reveal that the acid combination is hydrochloric acid. The air on the seacoast is so highly impregnated with salt that a lime can contain quite a percentage of it and the bricks can absorb a great deal more and give it out again in dry weather. If calcium chloride be present, it may be either originally in the lime or it is more often produced by washing down the front with muriatic acid, and the presence of calcium chloride is not so easily destroyed. Calcium chloride is a hygroscopic salt which can be partially destroyed, and in some cases entirely so, by washing down the front with diluted nitric acid. This forms a calcium nitrate which the rain will carry away completely. Where muriatic acid is used as a front wash, the combination of chloride and calcium is bound to occur, and once chloride of calcium is largely present, it being continually moist, forms a nucleus or a medium for the propagation of the germ of mildew (*penicillium glaucum*).

Maximilian Toch.

SINGULAR PASSAGE OF A SCREW STEAMER FROM THE TYNE.

A RATHER curious passage of a screw steamer has just been brought under our notice. The vessel in question is the "Tyne Queen," which recently left this river on a voyage to Drontheim. When off the Norwegian coast she experienced the heavy weather which lately prevailed in the North Sea, during which she pitched to such an extent that she struck the rocks in seven fathoms water. As she did not seem to have received any injury, and made no water, the voyage was prosecuted to Drontheim in the ordinary way, where she loaded a cargo of sulphur pyrites, and sailed again for the Tyne. After discharging here it was deemed better to have a look at her bottom, and on taking her into the Graving Dock at Jarrow she was inspected by the surveyors of the Liverpool underwriters, who found that she had broken her keel, as well as some of her plating, besides starting a considerable portion of her riveting to a serious extent. The wonder then grew, how a vessel in this state had been navigated throughout the greater part of a tolerably long voyage without having given the slightest trouble to anybody. A closer inspection showed that the cement, with which the bottoms of most screw steamers are covered, had actually withstood the thumping which she had endured off the Norwegian coast, and that its unbroken skin had, for the time, done the work of iron plate! The vessel is still in the Jarrow Graving Dock. The Portland cement used in lining the "Tyne Queen" was manufactured by I. C. Johnson & Co., works at Gateshead-on-Tyne.

THE Vulcanite Portland Cement Company of Vulcanite, N. J., will begin the manufacture of cement on April 1, 1895. They will use the rotary cylinder process, same as the Whittaker Cement Company use. Any correspondence can be addressed to A. B. Bonneville, vice-president and manager, Siegfried, Pa.

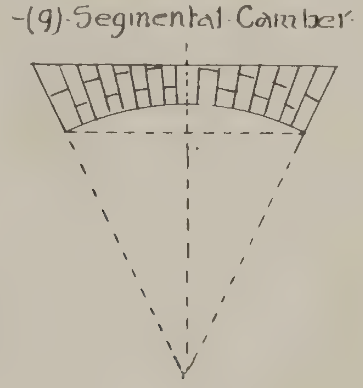
The Mason Contractors' Department.

Conducted in the Interests of the Builder and the Contractor for Brickwork.

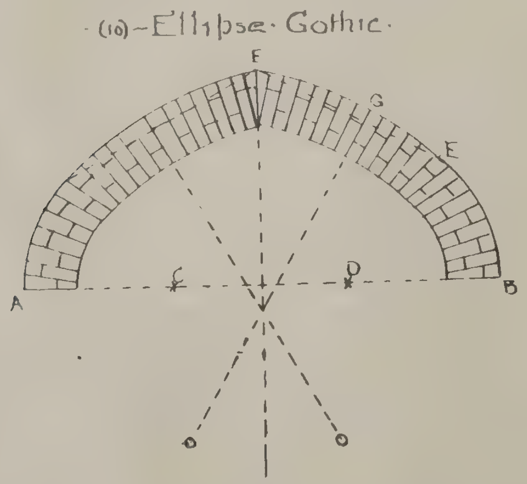
ORNAMENTAL BRICK ARCHES.

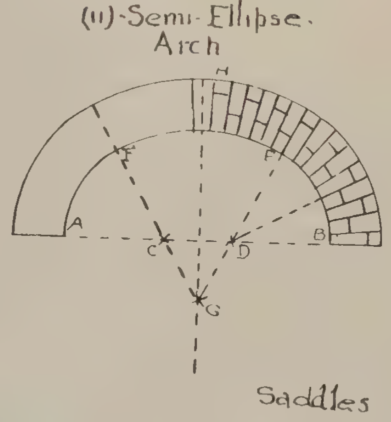
(*Continued.*)

Segment Camber. — The segment camber is somewhat like the camber arch, and is constructed with much less labor and looks well in a building. Lay out the height of the arch as required on the perpendicular line (see Fig. 9), and draw a line parallel to the span of the arch, and intersect it with the line of the skew back drawn from the centre. Lay the courses out the same as in the camber, and it is only necessary to cut for the beds and the upper line of the arch.

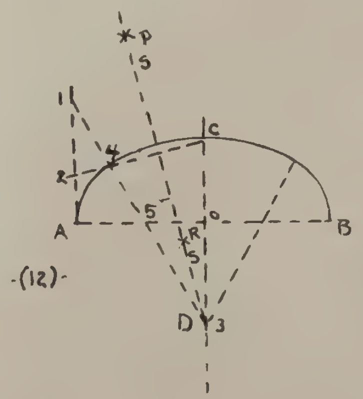


The ellipse Gothic is rather more difficult in the working than the general run of Gothic arches, owing to the different striking points. To draw this arch (see Fig. 10), let the distance *A B* be set off equally on each side of the perpendicular line, then divide it into four equal parts by marking the points *C D*, and with *D* as centre and the distance *A B* as radius, describe the arc from *B* to *E*, mark the point *B E*, equal with *B D*, draw the chord *F E*, and bisect it at *G*, from which point draw a line with the set square from any point *O*, and upon this line the centre is taken to draw the upper portion of that part of the arch as shown: the soffit curves are obtained in the same way. After the lines *A F E B* are drawn, they can be made to answer either for soffit or extrados by striking the other parts *greater* or *less* than those named, but the centre will do for either. The moulds for this arch are taken in the same manner as those in the *camber;* that is, it must be traced over with the moulds so that each course shall be *exactly* of one *size*, and the bevels must be taken separately. It is of the greatest importance that the mechanic should practise drawing this arch until he is thoroughly acquainted with every part; for *ellipse* Gothic, or Tudor arch, or *four centred* vary greatly, and by thoroughly understanding the principles of the one here described, he will be better able to reduce or elevate them to suit his requirements. The construction of this arch is slurred over more than any other we are apt to see, the mechanic forming two moulds to construct each side of the arch, which should *never* be done when the appearance of the arch is taken into consideration; and where great exactness in workmanship is required in ellipse Gothic or any other form of arch, whether of stone or brick, the mason should set out the full size of the arch in elevation on a drawing, with the joints, soffit, and extrados lines marked thereon. Lay the full size of drawing on a thin sheet of zinc, prick through the lines with a fine point into the zinc to the form of the required bricks, and then cut them to their requisite shape, being numbered for their respective positions in the arch; they can then be applied to the brick to be worked, and when they are formed they should be marked or numbered also, and when setting the arch the above drawing should be at hand and each course placed as correspondingly marked on this drawing.





Semi-ellipse arch (Fig. 11), which is somewhat like the ellipse Gothic, the difference being in their crowns; but the drawing is quite different. In drawing this arch divide the span into three equal parts as shown at *A*, *C*, *D*, and *B*, then with *D* as centre, and *D B* as radius describe the arc from *B* to *E*, equal to *D E*, and the same on the opposite side to *F*; then with *D* for centre, and the distance *D C* for radius, describe an arc, cutting the perpendicular line in *G*, and from this point with the distance *G F* describe the crown *F E*; the outer curves are taken from the same centres, only with a greater radius. To get the moulds correctly, that is for ornamental brickwork, where all the brick should be of the same size, this arch must be traced over in the same way as the camber and ellipse Gothic, that is, take the thickness of the brick, and set it equally on each side of the centre line at *C*, then draw the lines to *G*; this will give the size of the

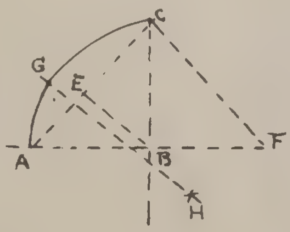


mould very nearly; then if they are worked alternately down to the springing line, it will easily be seen where they want easing. There is no doubt but what these arches are stronger in every case when they are built from their centring lines, and is the easiest method; but the appearance is not so good as when the courses in the arch are all of the same size, and for face-brick work their stability is sufficient for the amount of weight they have to bear.

The adjoining mode (Fig. 12) is probably the closest approximation that can be arrived at in showing the true ellipse by the compasses or from centres, which I know will be useful for the mason to understand. To draw it erect the perpendicular line *A* 1 at right angles to the conjugate axis, and make it equal to *O C*. Divide *A* 1 into two equal parts, and draw the dotted lines 2 *C* and 1, 3, describe the arcs *J R* from the centres 4 and *C*. Draw the line *S S* until it cuts the continued transverse axis at *D*, this being the centre of the larger curve of the ellipse 4 *C T*. Next draw the line 1 *D*, and where it cuts the conjugate axis at 5 is the centre of the end curves of the figure. The foregoing is probably the most ingenious method of drawing the ellipse by the compasses or by centres that has yet been discovered.

The necessity for taking the face moulds for brick or stone arches constructed from ellipse curve from the full-sized drawings of the arch arises from the fact that these arches are generally *crippled* at the junction of the small and large curves *T*, and they should be nicely arranged in this respect by the mechanic; also that all the face moulds of the arch should be exactly alike, especially for ornamental brickwork or masonry.

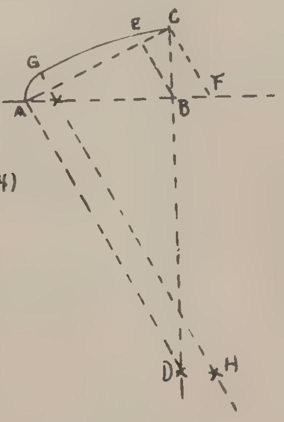
(13)



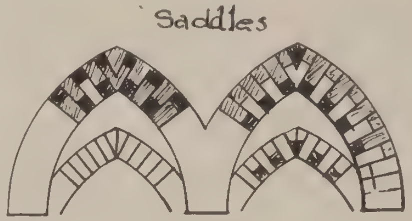
To draw arches whose height is greater than their half width.—(Fig. 13.) For arches whose height is greater than their half width draw *C F* and *B E* perpendicular to *A C*, then *E C* will be the smaller radius, and *E C* added to *C E* will be the longer radius *H*.

To draw an arch less in length than its half width. — The following plan has been put forward for finding the curves of arches and *ribs*. The fundamental rule that the curves should spring from the line of the impost has been abandoned by many. The following rule furnishes a principle which gives the centres of all these curves with perfect certainty and perfect harmony, at the same time furnishing what is further requisite, an independent projection for each rib: if the arch to be drawn be less in height than the half width, let *A B* (Fig. 14) be the half width; *B C* the height; join *A C*; draw lines from *B* and *A* perpendicular to *A* and *C*, and the points *E D* are thus required. Then *E C* will be the smaller radius, and *E C* added to *A D* will be the longer radius, *H*.

(14)



Saddles. — Where two or more arches are set close together, saddles ought to be cut as shown in Fig. 15, and not a continued straight joint; for although this is often done, there is no bond between the two arches. In the same cut is shown the manner in which ornamental Gothic arches are "keyed" when red, black, buff, or white brick are used to build them, as well their disposition when tuck pointed for ornamental work, and the straight-jointed key where strength is desired instead of ornament.



The various forms and designs of the arch are of an almost endless description, and as practised in various countries form a most interesting study for the mechanic; but I trust I have described enough to answer the practical mason, and to further his knowledge and examination of higher principles of arching, which are founded on the unerring laws of geometry and proportion.

ARCHIE.

EDITOR OF THE BRICKBUILDER:

Dear Sir, — I was very much interested in the article by Mr. Cram on "The Use of Brick in Domestic Architecture," and would be glad to have him go more into details of construction. As, for instance, how did they tie the two walls together? Iron ties or brick laid across air space? If the former, would the two four-inch walls have sufficient rigidity, or if the latter, would dampness not show on plastered wall? In fact, can a wall of that character (two four-inch walls with two-inch air space between) be depended on to keep dampness out where plaster is placed on the brick?

I have never built a wall of that character, furring is the usual practice here; but if it can be vouched for as all right and sufficient, would like to try it on a small brick cottage I expect to erect for myself. I understand that the dampness is not from moisture in the brick, as is popularly supposed, and have always had my doubts about the efficiency of damp check close to grade line, as I do not think dampness will rise in brickwork to any appreciable degree. The moisture usually showing on a plastered brick wall is deposited on the wall on account of the difference in the temperature of the wall and the air of the room. Now whether the English houses, shown by Mr. Cram, are free from this trouble, by reason of the air space, is what I would like to know.

I would like to see your "Mason Contractor" department made a practical one, with correspondence from men engaged in the business in relation to their work. I would like to contribute to it myself if you would allow me, and tell my brother builders how I built a smoke-stack, the apparatus I used for hoisting material, etc.; would also like you to show (if not already done) detached brick residences suitable for forty-foot lots.

Respectfully yours,
A. H. COPE,
Contracting Brick Layer, Decatur, Ill.

[The columns of this department will be always open to our mason contractor subscribers, and we extend to them a cordial invitation to make free use of this medium through which to discuss all questions that may be of practical value in their business. — ED.]

THE MANUFACTURER.

DANGER SIGNALS.

A PAPER READ AT THE CONVENTION OF THE NATIONAL BRICK MANUFACTURERS ASSOCIATION, BY ROBERT W. LYLE.

FOR years I have endeavored to figure out why it is that people of intellect, after gazing upon the different branches of the clay industry, immediately conclude that they can do it as well as the most experienced clay manipulator. It is not so of other industries. The novice watches the potter throwing upon his wheel the jug or jar. He concludes it a lead pipe — a cinch — to do the same thing. Watchmaking, manufacture of shoes, or any other industry is never sized up in such a manner. As a matter of fact, any other industry is easier to learn than the potter's art. There must be something in the clay which operates upon the brains of such people. Did you ever notice it? Think it over.

The same may be said with regard to brick burning. While it is true that a person who burns brick is one that shovels coal, I should hesitate before placing my kilns in charge of a man who has no other accomplishment than the wielding of a shovel. I believe a danger signal should be hung out at this point.

Should a professional brick burner offer his services, the man who wears kid gloves and boards at first-class hotels, the red light, the danger signal, should be set out and caution be the watchword. You will find theory is his only stock in trade, — watered stock, emphatically.

A successful brick manufacturer should possess a thorough knowledge of the many burning processes, the construction of kilns, and fully comprehend all stages of brick burning. If this is impossible, he should have judgment enough to secure a thoroughly competent man to take charge of this most important part of his business. You will remember the old saying, that

> "He who would by ploughing thrive,
> Must either hold himself or drive."

This is true in the relation of manufacturing and burning of brick.

The most successful brick manufacturer is one who can take off his coat and handle any portion of the business. It is most difficult to delegate to laborers the requisite knowledge of the proper handling of machinery and clay. Without such practical experience, the brickmaker is of little use, no matter how well he understands his business theoretically.

There has been no industry in this country that for the last fifty years, proportionate to the amount of capital invested, has met with more failures than the clay-working industry, this state of affairs being brought about by the attempts of men inexperienced in the art, and is also largely due to the attempts of inventors to get up improved methods of brick moulding and new machinery of every description, having made success with their machinery in certain grades of clay, having advertised it extensively, and having claimed infallibility in that their machines would make brick out of any kind of clay, under any reasonable circumstances, and in a marvellous manner.

This often causes the inexperienced capitalist to put in his money and urge his friends to put in theirs. They see the success of the industry as compared under favorable circumstances, and take it for granted the same conditions can be attained wherever and whenever they choose.

TERRA-COTTA DETAILS USED IN THE PETER DOELGER BREWERY BUILDING, NEW YORK CITY.

EXECUTED BY THE GLEN'S FALLS TERRA-COTTA CO.

The machinery which might make brick suitable for some markets, under certain conditions, and with certain clays, would, in fact, be utterly worthless to manipulate clay mined in other localities. Danger signals should be hung thick around all such inventors and enterprises. Men seeking investments in clay-manufacturing directions should make haste slowly. Several acres of clay can be found out of doors in many directions. I can name several localities where millions of dollars have been irretrievably lost in the manner just alluded to. Capitalists seeking investments in clay manufacturing directions should always send samples of clay to be tested in various ways, selecting reliable brick machine manufacturers for that purpose, but never should the slightest confidence be placed upon chemical analysis. Here is where I hang out the most prominent danger signal. The scientist who claims to tell you all about your clay, what it will do and what it will make, is a humbug of the first water. He would be useful if the manufacture of chemicals, or drugs, was contemplated. There is no test in the world of value whatsoever, except the actual fire or burning test. We all know black clay will burn white, and white clay black.

In a word, I have no more faith in a chemist's analysis of clay than I have in the Irishman's definition of metaphysics. Pat was asked the meaning of the word, and replied: "Well, I meet yez on the street and I tell yez something I don't know, and yez don't know either. That's metaphysics."

Take two bricks exactly the same as to material; burn one in a muffle kiln, the other in an open kiln; examine them, and ask yourself if chemical analysis will determine such a result. The burning of small samples in small kilns, the samples being manipulated by hand, is of little practical value. Some clay will work satisfactorily under the soft-mud process, while it will prove absolutely worthless under the dry-press method. Here is another danger.

I have in mind a gentleman who purchased clay property. The samples were made by hand and proved satisfactory. He erected his works, spending fifty thousand dollars, and up to this date has not produced a full-sized brick of salable quality.

It is not always the safest thing to rely upon samples made by a firm or a manufacturer interested in the sale of a particular kind of machinery. If he is a shrewd man and has an eye to business, it is to his interest to make and burn a few samples and forward to you fine specimens, to the end that his machinery may be purchased. He will not hesitate to adopt any method of treating the clay, so long as satisfactory samples are produced. His methods might, or might not, be practical to engage in extensively. This is a danger which I signal most forcibly.

The selection of proper machinery first, and the erection of proper kilns second, seem to me to be the foundation of success. In my travels I have seen enough rejected and useless brick machinery to cover a ten-acre lot. The smooth, oily-tongued salesman induces the man, who has money to burn, to purchase his brick machinery, showing beautiful photos or cuts of the same, guaranteeing almost anything and everything. You will agree with me this is a rock upon which many a concern has been wrecked.

After examining most carefully hundreds of kilns, I am convinced that the down draft process of burning is the only suitable and economical method. With the up-draft process of burning, the tendency of heat to rise and cold air to follow, contracting the heated current as it rises, drawing in the cold from the side as it goes up, is fully in accordance with nature's laws; but it does not attain that which is desired in utilizing the products of combustion inside the kiln, and is consequently much more costly than the down-draft process.

Where the heat has a downward tendency, it is much easier to cause it to spread to all portions of the kiln, and it is then enabled much better to do the work satisfactorily.

The continuous kiln, in my opinion, has come to stay. The lateral draft of the heat is much more fully and economically utilized, owing to the fact that the heat can pass continuously through the different compartments, until it reaches a compartment at such a distance that it becomes modified in intensity to such a low degree that it is fully adapted to the drying process, which is preliminary to all burning; thus the cost of fuel is brought to a minimum.

At this point it might be well to refer to the manner of building kilns. One of nature's laws is, expansion of all bodies. Therefore when a proposition is made by a professional kiln builder to construct rectangular kilns, with square corners and straight walls along the sides, there should be a danger signal hung out at this juncture. While rectangular kilns are all right, so far as burning is concerned, and where capacity is desired, the difficulty of maintaining straight walls with square corners, and preventing the walls from cracking and bulging, is an expense which no man ought to experience the second time. This can be avoided by building the walls on a slight outward curve, with round corners, and curved walls along the heads of the kilns. When such kilns are properly supported from the outside by efficient truss-work or buttresses, and lined with suitable fire brick, permanency in construction is assured.

When we enter the domain of manipulating clays, we strike a field pregnant with natural laws that must not be ignored. The unpleasant conflict between advocates of soft-mud and stiff-mud processes and the dry-clay promoters of brickmaking has, in a measure, subsided, and there seems to be a calm. Dry process brick machinery has come to stay. Unfortunately, the inventor of this class of machinery has bent his efforts to utilize all kinds of clay in his process. It is a fact that when this system has been adopted, and clay suitably prepared, fairly satisfactory results are acquired, but oftentimes at a much greater expense than it would cost to manufacture brick if the soft-mud process were adopted. A loamy, plastic clay, in low ground that is nearly moist at any and all times of the year, can be moulded into brick and dried as cheaply as clay can be dried sufficiently to mould by the dry-press process. Such material, when it has to be manipulated, ground, screened, tempered, and pressed, and oftentimes dried, before going into the kilns, is, to my mind, a foolish and expensive system.

Then, again, to undertake to work varieties of loamy clay, that make an excellent soft-mud brick, by stiff-mud process, is a violation of the natural law, — an adaptation that nobody ought to undertake to repeat at this late day and age of the world; and so we might refer in detail at such length as would exhaust your patience, and not cover the field that comes before us in these departments. Let danger signals be hung out often, and surround these various difficulties that must be and are daily encountered by the manufacturing fraternity.

There is an old adage, "A hint to the wise is sufficient." The great trouble is, we have to deal with so many people of the opposite character. Wise men are the ones that learn, and generally pay little for experience. Fools learn in no other school, and, as a class, never learn anything. After all dangerous conditions have been avoided, and wisdom, prudence, and judgment displayed in the seclection of clay, machinery, erection of kilns and plant, we are at last in condition to try our luck.

Allow me to condense the foregoing into four propositions, before each of which I wish to warn you of danger: —

1. The selection of a suitable site and clay property.

2. Absolute proof that the machinery which you contemplate using is suitable for such material.

3. The erection of kilns best adapted in shape and design to the burning of your machine products.

4. And most important, can you find a market for the goods? What is your opinion of a capitalist who invested over one million dollars in the manufacture of an end-cut common brick, the market absolutely refusing to receive one fourth of his output, demanding side-cut brick or nothing. I will not ask you to guess as to the result of this enterprise; but one conclusion could be reached.

Does it not occur to you that in this year of our Lord 1895, inasmuch as so many ruts have been travelled over in the developments of this great industry, is it not folly at this late date for others to go on with their ups and downs, successes and failures, operating in the ruts that others have travelled in before for centuries? Every rut that has particular disaster along the line should have its danger signal prominently hung out, and everybody warned of its liability.

The most important subject connected with the cost of manufacturing brick and building material of every description is labor. The erection of numerous clay-working plants for the manufacture of almost everything imaginable has created such competition that success is impossible without the greatest care, and most careful handling of all help employed.

My brother manufacturers should, at this point, plainly observe a prominent danger signal, and it might be well for some of them to invest a small amount in the purchase of short-sight spectacles; then look carefully through the several departments in their works, and determine in how many places two men are doing the work which should be accomplished by one. In many factories I have visited, spectacles would be unnecessary. I believe the bane of all brick manufacturers' existence is the everlasting and never failing to materialize, pay day. The introduction of labor-saving machinery is most essential, and a topic upon which I would gladly dwell if time permitted.

Right here a word of suggestion might not be amiss to the craft, which, in numbers, far exceeds its representatives here in this national association, and in this, I refer to labor organizations, so called, the object being to control prices paid to its members. Whenever it becomes necessary for labor to so organize, and a walking delegate is sent forth to represent the men, should such a delegate trespass upon the ground and through the plant of a brickmaker, let the red light be presented before him at once, and immediately seek, if possible, to bring about such a state of affairs with your workmen as shall disarm this delegate of his power for injury.

There are altogether too many professional men for the laborer to support, and do it without serious embarrassment to his own reserve for a rainy day. Between the preacher and the lawyer, life and accident insurance, etc., expense of maintaining the walking delegate should be eliminated. The average workman is consistent in his request, moderate in his demands, and if the demands are met in the proper spirit, he will seldom cause trouble. It is their business to work; their very existence depends upon it; and since we are all desirous of making our living by the sweat of their brows, due consideration must be given them if satisfactory labor is desired.

Another thing that might not be amiss here is suggested by the memory of an incident that happened only a few years ago to a man who was very prominent as mayor of a large city, and also a manufacturer of brick, who, in the days of his adversity, called in the family physician and requested him to examine his throat. Opening his mouth very wide, the doctor looked in and saw nothing particularly alarming. The patient said, "Look again, I know there is something wrong. I have swallowed a brick yard, machinery and all." This man was in the last stage of delirium, occasioned by the excess of the drink habit; and signals cannot be put out too often, guarding against the danger that the drink habit emphasizes upon manufacturers and workmen.

Such disaster is possible in connection with the manufacture of brick, and in the handling of machinery through the various processes, and the manipulation of clay, drying and setting brick, until the last and most important and most expensive of all, the burning. Whiskey is the poorest way that has ever been tried to open the door of success with brick or any other kilns. Let the red light be hung around the beer kegs and whiskey bottles, and to emphasize a remark that we remember is attributed to Josh Billings, when speaking of the proper way in which to train children in the way they should go, "It is a very good thing for parents to travel that way themselves once in a while."

Sobriety is absolutely essential to the successful operation of a brick plant. There is a danger more local in its general application than anything previously alluded to, which may be well to mention, and that is the organization of brickmakers' trusts, or combinations, for the purpose of maintaining prices of brick. Those who have had experience along this line know well the dangers that beset the craft. In the average size cities, combinations can be maintained, if properly managed, that will prove beneficial to all concerned,— the builder, the contractor, as well as the manufacturer. The particular danger of combinations of this character, and where, I believe, the red light should be hung out after the combination is completed, and all have entered with good will and purpose, is the danger of putting the price of brick so high as to invite capital to engage in the manufacture, and thus break the combination and force the price of brick to a lower level than it had ever been before.

A law that should not be lost sight of is the law of equilibrium. If prices are made by any combination to go up too high, it is just as certain they will swing down below the line as they have been raised above it. This is not liable if reasonable and fair compensation for the use of capital is obtained. Let the experience of the past be a guide to future operations in this, and be satisfied with a reasonable and fair margin for the use of capital invested, wear and tear of machinery and plant, also the payment of good wages to men who perform the work.

ECHOES FROM THE CONVENTION.

THE man who goes into the brick business now, unless he is too bull-headed to ask advice, need make but few mistakes. — ALSIP.

THE brick business requires for its successful prosecution a high order of ability, including the skill of the engineer, a knowledge of mechanics, and good financial judgment. — ALSIP.

I HAZARD the prediction that in the cities of New York and Chicago (notwithstanding the vigorous opposition of rival paving companies) many of us will live to see granite blocks taken up and replaced by annealed paving brick. — ALSIP.

MEN who have made failures in brick usually attribute such failure to the wrong person or persons. Machine men have been abused, kiln men blamed, manufacturers of all kinds of brickmaking appliances have been execrated, forsooth, because they have sold machinery to some poor innocent, whom Divine Providence had intended to measure tape instead of making brick. — ALSIP.

AMERICA is earning a reputation for beautiful architecture and comfortable homes, and to the American brickmaker belongs much of the glory of wresting from Nature's bosom the materials out of which are constructed our massive temples of trade and commerce, our beautiful homes, our magnificent pantheons to religion, our palaces of art and learning, our mighty structures which challenge and compel the admiration and astonishment of the world. — ALSIP.

THE wise turkey, as it thought it would be, says, "I won't eat anything now. Thanksgiving time is coming on, and the farmer will surely kill you if you are fat, and sell you and take you to market." Well, what appeared to be the foolish turkey went on eating and ate all the good things of life and became fat. So Thanksgiving did come, and the farmer killed both of them, the foolish and the wise turkey, and in the lean turkey he put a rock and made him weigh more than the fat turkey. And the moral of that is, "Don't give up a good thing when you have it." — STORY BY BLAIR.

FIRE losses have been so frequent and disastrous during the past few years that it is almost impossible for brick yards to secure insurance. It would seem that fireproof construction in our business would be the easiest solution of this difficulty in construction of new yards; but for the better protection of old yards, I advise the appointment of a committee to recommend means and appliances for the prevention and putting out of fires in brick yards. — ALSIP.

A SHORT time ago, I wandered into an architect's office in Chicago, and, with that quiet persistence which characterizes some of the citizens of that town, I found my way into his private sanctum, to his private desk. Before sitting down I saw pasted in a conspicuous place on his desk this little announcement, "Don't tell me your troubles, I have got my own," — GATES.

I AM reminded by this, somewhat, of a very estimable old lady I used to know, whose habit it was to go out into the pleasant summer sunshine and gather a bloom which contained within its area an essence, a concentrated concatenation of bitterness, that would turn a strong man's mouth inside out, and spread it all over his face in wrinkly shivers. — GATES.

THEN as the shadows of the night were coming up I saw what promised to be the last of this fleet coming with her little handkerchief of a jib, and watched with bated breath for what we thought could be but another victim, but the watchful eye of the skipper bore witness to a generation of storm fighting ancestors, and his hand faltered not the least bit as, steering just as closely as he could to the lighthouse crowned end of the breakwater, he, peeking his sails the least little bit, and using the force of the storm to guide him, guided his ship up into the mouth of the river and into safety. — GATES.

I SAY you are better men than you would have been without the trials and troubles of the past year, and I greet you as captains who have piloted your ships safe into the harbor in the times that have tried men's souls. — GATES.

I SAY that a hermit who lives alone, cut off in the desert far from all outside influences, never can have that breadth of character that comes to men who are in the race of every day affairs and are continually meeting and conquering temptations. — GATES.

IN the somewhat remote past, in the time of the Roman Empire, there was a large class of people who were all tied up in maritime affairs; they were called galley slaves. — GATES.

NO man, in my opinion, unless he has got the sand and the grit to withstand these storms and these tempests, will endure in any pursuit of life, and it is just as we meet, encounter, and successfully battle with these storms that we feel ourselves strong. — ITTNER.

CLAY workers should read and subscribe for all the clay journals. It takes men of brains now to manufacture brick, and you should keep abreast of the times. There are several good publications, take them all and learn what your contemporaries are doing. The manufacturer of clay, especially brick, should be familiar with literature and art. — BLAIR.

A GOOD burn is "the consummation devoutly to be wished for"; it is the "end all and be all" to a brick dealer. There is hardly any use nowadays for soft or salmon brick; the architects will not have them. I believe they are right, as anybody can burn pale brick, but it takes a skilled workman to make a good hard burn. If the architect holds all parties to the same standard, it will elevate the calling. It is the one who makes the poor quality of goods that cuts the price in order to sell them, and you who make a good article have to reduce the price to the same scale as your competitor. — BLAIR.

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THE BRICKBVILDER

OFFICE 85 WATER STREET BOSTON

BRICK AND MARBLE IN THE MIDDLE AGES.

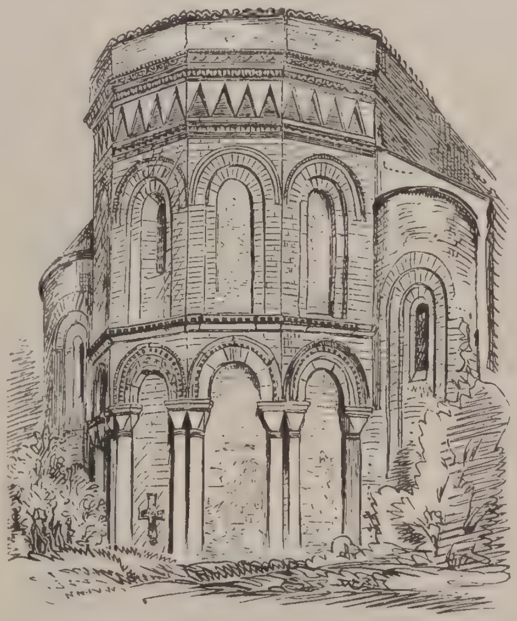
G. EDMUND STREET.

CHAPTER VIII.

(*Continued.*)

THE last time I was here I found myself, in the middle of making a sketch of the west front of Sta. Fosca, suddenly struck by the strange likeness of its octagonal cloister to the most typical elevations of the Byzantine palaces in Venice. These always have a centre and wings divided by piers; and whilst the arches in the centre are of ordinary proportions, those in the wings are narrow and considerably stilted. In Sta. Fosca precisely the same effect is produced by the elevation of the three sides of the octagonal cloister, two of them being reduced in width and seeming to have narrow stilted arches, owing to their being canted and not seen in true elevation. I confess I could hardly help thinking that here I saw the accidental germ of an arrangement which, commenced in Romanesque or Byzantine buildings, was imitated in many of the finest of the Gothic palaces, and was revived with invariable persistency in the Renaissance.

The return to Venice was more pleasant than the journey out had been. The water had risen enough to cover the mud everywhere, and now a vast expanse of apparent sea was lighted up by the hot sun, and in the far-off distance the horizon was lined with the long picturesque range of the Alps, tender and transparent in hue, and sweet reminders to the dwellers on this monotonous lagoon of the world which lay outside their boundaries in the far north. On the road we stopped at Mazzorbo, where there is a dated example of a Gothic doorway. This has a square-headed opening, and above this an ogee canopy or label over a figure of our Lord, and some kneeling figures. The date inscribed on it is A. D. 1368.



EAST END, STA. FOSCA, TORCELLO.

Farther on Murano is passed, and a halt made for a visit to the church of San Donato, once a building of the highest interest and well known to all readers of Mr. Ruskin's books. Unfortunately my first visit to this church was after it had been in part "restored," in the largest and worst sense of the word. The old brickwork was being renewed, plastered, and painted up, till most of its interest had vanished; and now, I fear, only those who saw San Donato some ten years ago can have any idea of its architectural value and interest. This was chiefly centred in the east front, where there is a central apse with a lean-to end to the aise on either side. The wall is divided into two stages, by a bold stringcourse and double line of chevrons formed by recessing the brickwork and inserting panels of colored and carved white marble. The lower stage is arcaded mainly in red brick, whilst the upper has a wall deeply recessed behind arcades under the eaves, with delicate balustrades between the columns which carry the arcades. This upper part of the building is mainly of buff-colored bricks, with thin lines of red to mark the pattern of arches, and it is curious that the light bricks are much larger than the red.[1] The pavements here are very fine examples of opus Alexandrinum, with a more than usual proportion of black marble, and there is a grand mosaic in the apse, of the Blessed Virgin Mary and our Lord on a gold ground.

One or two Gothic houses in semi-ruinous condition, and a very fine fragment of late Byzantine work quite in ruins, — the Palazzo da Mula, — remain in Murano, but of these there is such good store in Venice itself that we may pass them by.

Most visitors, I suppose, go to Murano in order to visit Dr. Salviati's glass and mosaic manufactory. He has succeeded in reproducing a material quite equal to that used in the old mosaics. Still more difficult feat, he has succeeded also in making glass so like the old Venetian glass in color, texture, and design as to puzzle all ordinary judges. I cannot sufficiently admire or praise the singular power which Dr. Salviati has shown in the education of his men. A party of six or eight made for me before my eyes, in a few minutes, a tall, delicate, and richly adorned goblet, in which every part was done by eye and fancy; no modern accuracy was attempted, and the result was a thoroughly beautiful and artistic work. All artists know how difficult it is to get a workman nowadays out of the hard mechanical groove of dull uniformity, and Dr. Salviati's success is an encouragement to all of us when we are tempted to despair of making the attempt.

From Murano a few minutes take us again into the watery streets of Venice. We have now seen the two buildings which ought first of all to be studied, Torcello and St. Mark's, and in them we have the key to everything that follows. The Venetians commenced in their earliest buildings with works which showed but little original invention or power. It was their fortune to have, by reason of their situation and their commerce, a great connection with the East. They received, therefore, a great impetus at the first from Byzantine art. Nowhere in Europe was so great an influence of the kind exerted; and

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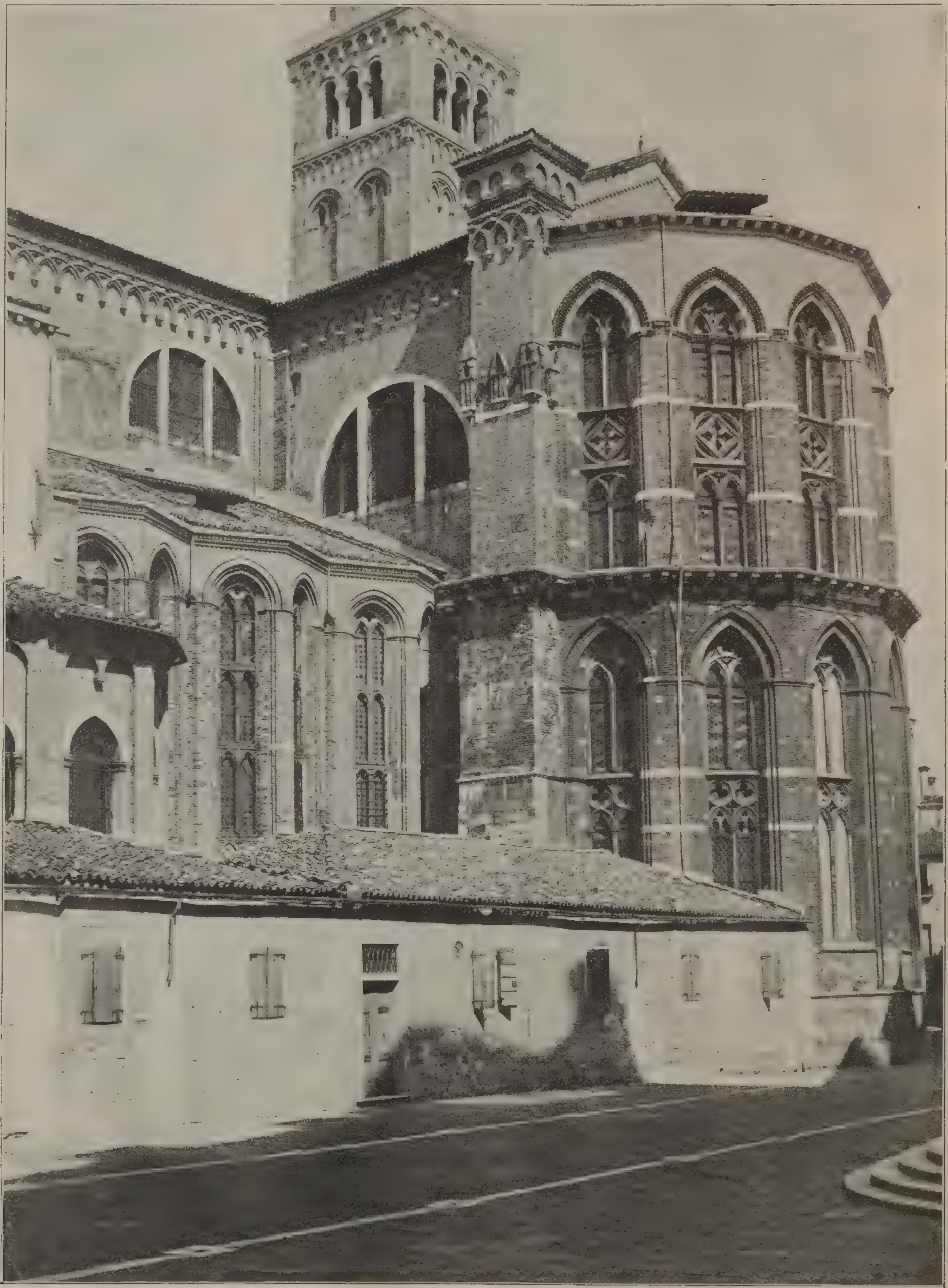
[1] The red bricks are 2⅛ inches thick by 9½ inches long, whilst the yellow bricks are 3¼ inches thick by 12 inches long.

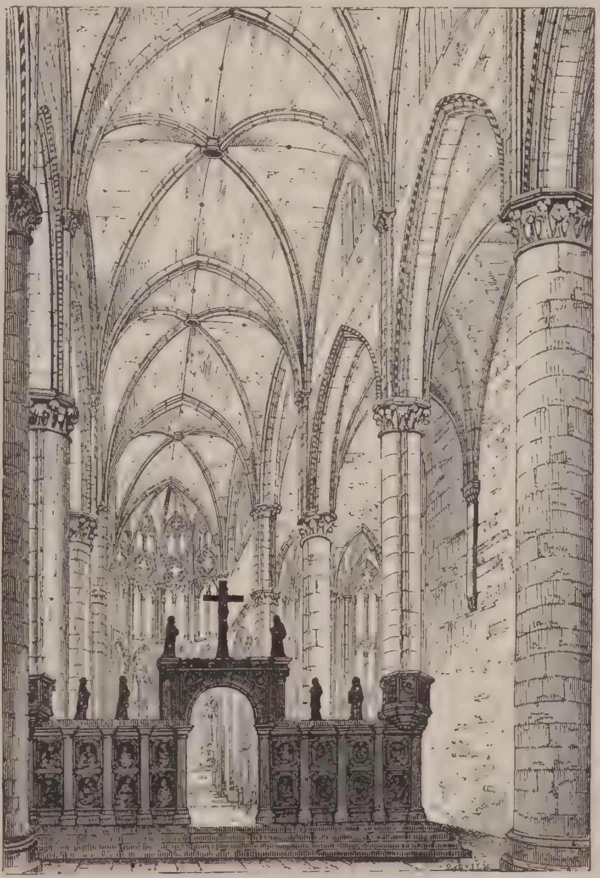


APSE OF THE CHURCH OF THE FRARI, VENICE.

Supplementary Illustration to "Brick and Marble in the Middle Ages."

to us, whose early architecture was almost entirely Romanesque in its origin, it has a special interest and novelty. But if the early Venetians copied Byzantine models, employed Byzantine workmen, and thought rather more of the beautiful colors for which their Eastern acquaintances gave them a taste than did their neighbors on the mainland, it must be frankly conceded that in later times they developed a very original form of Gothic out of these very materials, and owed comparatively little to any external aid in their great works of the fourteenth and fifteenth centuries.

The first business of a tourist in Venice is to secure a gondolier with intelligence enough to understand his proclivities, and patience enough to humor them. I have more than once or twice had to thank my gondolier for showing me old work which otherwise I should never have seen, and I am grateful accordingly. I am grateful, too, whenever I think of a gondola, for the most luxurious machine for sketching from which has ever been constructed; and the more so, when I recollect how for an hour at a time I have been persecuted in most Italian towns by all the idlest, dirtiest, and worst-behaved people of the place whilst I have made my sketches of their buildings. In a gondola in Venice one knows no such troubles, and the sketcher's life, as long as he can work in it, is as happy and undisturbedly serene as is possible. But no artist must suppose that everything worth seeing can be seen from the water; a few walks will convince him that, in the narrow *calli* as well as on the water-side much that is interesting is to be found; and when he has studied Venice both by boat and by pavement, he will find, as I do, that the subject is too large for a chapter, and requires rather a volume for its thorough elucidation.


INTERIOR OF STA. MARIA GLORIOSA DEI FRARI, VENICE.

The buildings of Venice divide themselves into two great classes, the churches and the civil buildings; of these the former is the smaller and the less interesting class. But as we have already seen at St. Mark's and Torcello the earliest examples of the churches, it will be best to say all that has to be said about them here, and to take the palaces and houses by themselves afterwards.

We have seen that St. Mark's was built in the eleventh and twelfth, and largely altered in the fourteenth century. Between these two periods little, if anything, was done in church building in Venice; or if it was, it has disappeared. Just as in Germany, the thirteenth century seems hardly to have existed for Venice, and we go at a bound from the simple, nervous round-arched work of St. Mark's to the here somewhat poor and tasteless churches of the fourteenth century. One or two small campanili — San Polo, San Samuele, and San Barnaba are the best — remain to show what the size and character of the earlier work were. They have plain arcades in the walls, rising from the ground to the belfry, and this has generally windows of two or three lights carried on shafts. At San Barnaba[1] a spire with parapets and pinnacles was added to such a steeple in the fourteenth century, the spire being circular in plan and build of round-ended bricks. San Paterniano has an hexagonal brick tower with two light belfry windows, also of Romanesqe character. The whole of these works are of brick, and usually the walls batter outward towards the base. In this respect, as in the general design, the great tower of St. Mark's follows those early examples, as also in its means of access to the top, which is a continuous slope in the thickness of the wall in place of the newel staircase in use all over the North of Europe. Finally, all these older works are very small and modest in scale and design.

Let us now give up all thought of early works, and see what the fourteenth and fifteenth centuries did for Venice in the way of churches. Taking them in their order of merit, we will go first to Frari, the church of the Franciscans, thence to SS. Giovanni e Paolo, that of the Dominicans, to the Madonna dell' Orto, San Stefano, the desecrated church of the Convent of La Caritè, now forming part of the Accadenia, San Gregorio, Santa Zaccaria, San Giacomo del Rialto, and some smaller fragments.

I must confess that on the whole, in spite of the grand size of some of them, I was rather disappointed on first seeing these buildings. One cannot but be impressed with the magnificent size of such a church as the Frari, with its many interesting details, and its monuments and woodwork. But in spite of all this, there is something wanting. I had not expected larger churches, but I had imagined that their style would be more pure, and at the same time more unlike what I was accustomed to elsewhere. The impression they left on my mind was decidedly that they were very inferior in almost every respect to churches of the same size and degree of ornament in the North of Europe, whilst in scarcely any point did they seem to me to have features which could with any advantage be imitated by us. I had allowed myself to expect a very different result, and was proportionately disappointed. There is no church in Venice (in what I am now saying I mean always to except St. Mark's) comparable either to Sta. Anastasia or to the cathedral at Verona in the interior; and the exteriors, though fine as examples of the bold use of brick, are nevertheless not first-rate nor at all superior to what one sees elsewhere.

Sta. Maria Gloriosa dei Frari ought first to be described, as being certainly the finest of its class. The first stone is said to have been laid on April 3, 1250, Nicola Pisano being the architect. The campanile was begun in 1361, under Jacopo Collega, and completed in 1396 by Pietro Paolo, his son.

The first impression of the church on landing from the gondola on the desolate-looking piece of pavement which here, as in many of the Venetian churches, forms a court between the canal and the west front, is not pleasing. The design of the west front is nothing short of being positively ugly; it is finished with a great sham gable, with a curved outline, somewhat akin to the degraded taste of our worst Jacobean art, and entirely without any beauty or even picturesqueness of appearance. The doorways, too, are particularly poor, consisting of a succession of twisted and reedy mouldings, thin and shadowless, like so many cords stretched from cap to base and round the arch, without any proper distinction of jamb and archivolt.

(*To be continued.*)

"Rational Building" is the title given the translation by George Martin Huss of M. Viollet-le-Duc's article, "Construction," in the Dictionnaire Raisonné de l'Architecture. Macmillan & Company, Publishers, New York.

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[1] The twelfth-century bricks here measure seven inches by two inches, and are built with a half-inch mortar joint; they are of red and yellow color used indiscriminately, and, though good and lasting, extremely rough in their make.

THE ART OF BUILDING
AMONG THE ROMANS.

Translated from the French of Auguste Choisy by Arthur J. Dillon.

CHAPTER II. — *Continued.*

SPECIAL CASES IN THE CONSTRUCTION OF VAULTS; MEANS OF STRENGTHENING; BUTTRESSES, ETC.

UP to this point the methods adopted by the ancients in the construction of vaults for obtaining auxiliary supports seem to have belonged to one of two types: to the system of armatures of bricks with radiating joints, either open networks or isolated ribs, or to the system of armatures of flat laid bricks, the thin linings. This classification is, of all that could be attempted, perhaps the least incomplete, but it fails to show the exact conditions. There can be no absolute division; sometimes the Romans made a choice between the two systems, but sometimes, on the contrary, their monuments show both types associated, as is the case in a hall of the Palatine (Plate VI.), where the vault has a system of transverse ribs carried on armatures of flat-laid bricks. The two methods of support are complementary, and the architect's aim was to unite in the auxiliary works the continuity of the lining with the rigidity of arches with radiating joints.

In matters of construction it may be said that the Romans had no fixed and general rules; the needs and resources varied infinitely, and the Roman builders wisely judged that rigidly unchangeable methods were not compatible with such a diversity in the conditions to be met. Hence, there is to be found no exclusive preference for any particular material, or for any particular form of structure. In Rome, brick was used for the armatures of the vaults; in Pompeii, for example, the material of the armatures was entirely different, and in consequence the aspect of the vaults was greatly modified. The architects no more limited themselves to the use of squares of baked clay than to the forms of the ribs and linings used in Rome. They still kept the auxiliary support between the temporary centering and the body of the vaults, but there is no longer found an equivalent of the cunningly built armatures we have been studying. Here all was reduced to an unbroken crust of tufa mixed with mortar, to a species of paving of small stones which enveloped the centering with a continuous covering; the armature was transformed into a thin vault of almost entirely rough material, which, like the linings of flat-laid bricks, sustained the entire weight of the upper part of the vault itself. This method of support, which is that of the greater part of the vaults in Pompeii, is plainly visible in the galleries of the two theatres, in the rooms in the lower story of the house called that of Diomedes, etc.

In Verona neither bricks nor tufa, but the round tiles of Adiga, were employed for the same purpose, and alone formed the envelope of the centerings and the support of the vaults in the corridors of the amphitheatre.

Finally, when the vault was of small span, and only slightly raised above the level of the ground, the Romans, changing their methods, used neither centering nor armatures, but moulded the vault, as it were, on a core of earth. This is the case in a vault discovered in the ancient cemetery of Vienne;[1] this is also the case in the vaults that honeycomb the walls of the sub-basement of one of the principal temples that rise on the platform of the Palatine. In this second case the earth that served as the mould remains in place, just as it was heaped up by the Roman builders.

Thus the methods of economizing in the provisory works changed, though the fundamental thought remained the same; and I wish to show, by a few more variations, how many were the aspects under which this idea presented itself in ancient days.

I have spoken only of vaults with curved surfaces: the curvature of the centerings was in itself a complication, and the Romans pushed their search for economy to the point of making the surfaces plane. This was attempted in the theatre of Taormina. The large niches have, instead of a vault with a curved intrados, a sort of broken ceiling, a pointed vault (Plate XV., Fig. 5); this queer form can best be conceived as being an ogive, where each leg is a straight line; the centering in a vault of this kind could evidently be made of two abutting joists. This instance, moreover, should not be thought to be an isolated example in Roman architecture; I have observed the same artifice on the plain of Rome, not far from the round end of the Circus of Maxentius, in ancient constructions of modest aspect, where the long vaults had a broken outline like that of the niches at Taormina. The centering of these vaults can be likened, with the greatest exactitude, to the framing of a gable roof. It would be impossible to push further, or to apply more freely, the principles of economy which I have been endeavoring to put in their true light.

With this liberty in the choice of methods, there was no circumstance which the Romans could not put to profit. They recognized that the materials pressed more heavily on the armatures at the summit than at the springing of the vaults, and they therefore sought different arrangements at the two points. Thus the arch shown on Plate XV., Fig. 2, is built at the springing of solid masonry of large bricks, while at the summit it is reduced to an open network carrying a mass of rubble. Thus again (same plate, Fig. 1) the great arches of the lower story of the Pantheon are built, at the springing, of interlocking bricks, and above consist of three concentric and independent arches, of which the first, once in place, served as a centre for the others.[2]

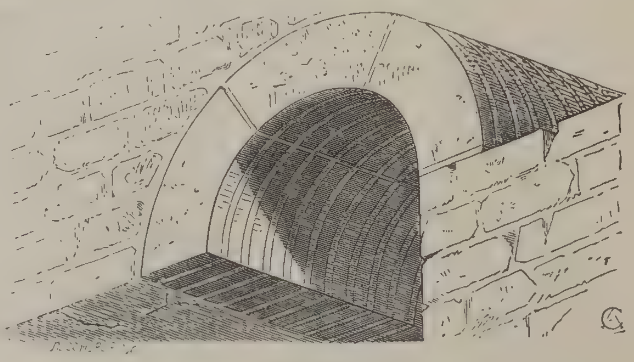

Fig. 52.

Moreover, we find the Romans utilizing the adherence of the mortar in order to build small vaults entirely without centerings: this can be seen in certain aqueducts in Greece, of which one can take as an example that of the Propyleæ of Eleusis.

The bricks, in the shape of a circular sector, are laid in thick beds of mortar; the two bricks at either side (Fig. 52) are easily put in place and stick to the section of the vault already finished; then the third key is put in the open interval, and the vault is thus completed without any centering whatsoever.

When the Romans had to strengthen a vault at any particular point, when for instance it was necessary to support an additional weight, a partition, for instance, they put aside, for the moment, the practice of building the ribs flush with the rubble and made them salient; sometimes these were carried on pilasters, but ordinarily they were salient only near the top, the lower part remaining flush (Fig. 53). Thanks to this arrangement, the vault was strengthened at the overloaded points, while the pilasters were suppressed, and the hall, remaining unencumbered with projections, had smooth and continuous walls about its entire circumference.

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[1] To-day destroyed. See for the details of this vault the work of M. Le Blant on "Les Inscriptions chretiennes des Gauls" (Tome II., p. 125, inscr. No. 454): an engraved stone, in the embankment forming the core, left an imprint on the masonry clearly showing the method of construction.

[2] These arches served to carry the weight of the upper part of the vault on to the solid parts beneath: that is, they are relieving arches. They are almost entirely filled with masonry, but it is clear that they were filled after being built on centres. To use the filling of arches such as these as the centering, would be to fail to attain the desired end, for it would be obtaining the exterior appearance of relieving arches while really there would be a continuous wall, which would transmit the pressure vertically, just as in the absence of keyed arches.

It would be, I think, superfluous to multiply the examples of special arrangements used under differing circumstances; there can be seen in them all the same manifestations of the same principles of studied economy, which everywhere, in spite of the diversity of their applications, show themselves with the same clearness. Having thus gone over the methods of construction as far as necessary, I will pass on to the question of the thrusts of the vaults.

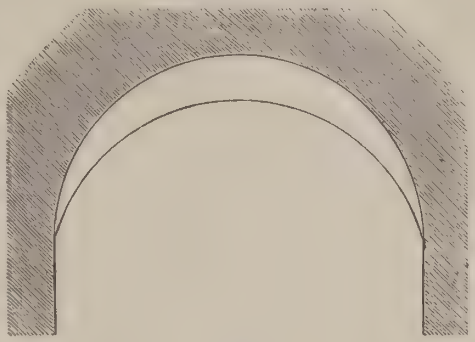


Fig. 53.

At the first glance one may be inclined to ask himself if this question of thrusts should not be put aside as being foreign to the system of construction we are studying; for it is not, in fact, the problem of meeting the thrusts of a keyed arch: here all the parts of the vault adhere to one another, and we have a homogeneous mass, a monolith, and it would seem sufficient to give it a bearing proportional to its weight. It is one of the great advantages of monolithic vaults that they will stand without any auxiliary props, and this property was too elementary to escape the notice of the Roman builders. But they also perceived the danger of counting entirely on it. A vault, when finished, takes its final shape more or less slowly. It bends, sometimes for a considerable period, and the summit drops little by little, while the lower parts have a tendency to spread. To allow these movements to take place was to run the risk of serious damage while they were occurring; and, when they ceased, the vault would be in a state of interior tension comparable to that of a spring resting on two supports. It is not thus that the masonry should be allowed to act; it was better to prevent the deflection; and the surest means of doing so was to rigidly hold, between powerful spurs, the flanks that tended to move outwardly. This was, I believe, the origin of the buttresses used for the ancient vaults, of whose form, importance, and arrangement one can get a general idea from Fig. 54.

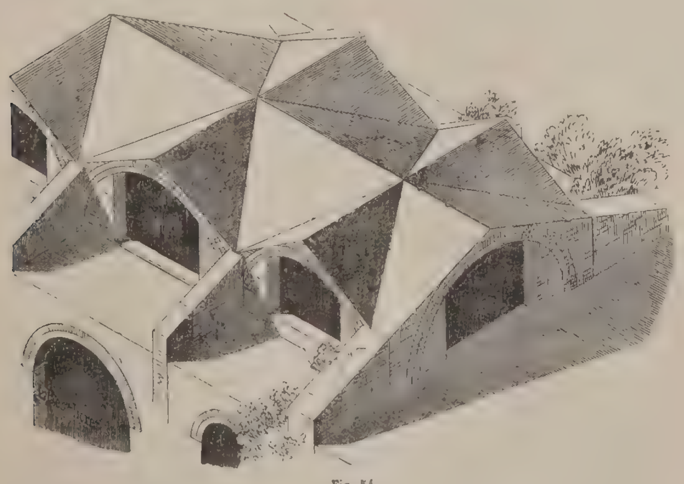


Fig. 54.

The buttresses of St. Maria Maggiore were like this, as well as those of the Temple of Peace, and except for a few unimportant details, those of all the great groined vaults, erected by the Romans were the same. The halls, covered by barrel vaults, had buttresses of smaller projection, and they were less often used, while in circular edifices it is the exception to find them about the drum. This gradation is so natural that it is sufficient to state it.

In general the Romans employed these exterior buttresses with much reserve. In strengthening the vaults, as well as in all other parts of their buildings, they avoided them as far as possible; and instead of building great masses especially to hold up the vaults, that would serve only to strengthen the edifice without other utility, they sought to obtain buttressing by a suitable grouping of the different parts of the buildings; and in this respect the careful study of the planning of their great monuments gives much valuable knowledge. I will not undertake to describe a series of combinations for obtaining equilibrium, which are as simple as they are ingenious, but which cannot be given any methodical classification. The ideas which prevailed are clearly enough indicated, and one can easily perceive the animus of the method which guided the Romans, by examining the plans of some of their great edifices, such as the Baths of Caracalla, of Diocletian, of Titus, the Palatine, etc., etc. One can there see with what care and with what fertility of expedients the Romans avoided the works intended only to assure the stability of the vaults. Almost all the parts which have this function are at the same time profitably used on the interior for the purposes for which the buildings were erected.

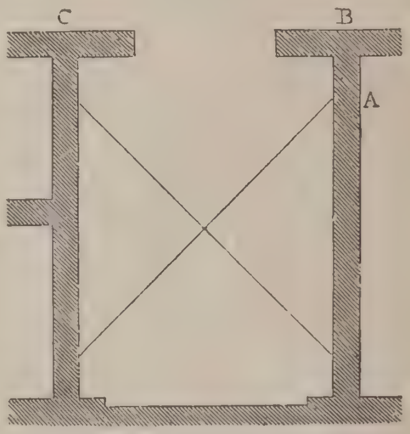


Fig. 55.

If it was a question, for instance, of buttressing the groined vaults of a rectangular hall, instead of starting the groins from the angles of the hall, which would have necessitated the use of projecting buttresses, they placed them at a certain distance from the exterior wall, B C (Fig. 55). The extreme end of the side wall, A B, served as a buttress, and, provided that the hall was longer than it was wide, they could combine this advantage with those connected with the use of groined vaults on a square plan (Fig. 40); and at the same time the buttresses were incorporated in the edifice, so that the useful space was increased, with no corresponding increase in expense.

This arrangement is met with, one might say, wherever there are intersections of barrel vaults. The Baths of Caracalla in particular, have numerous and remarkable examples of it.

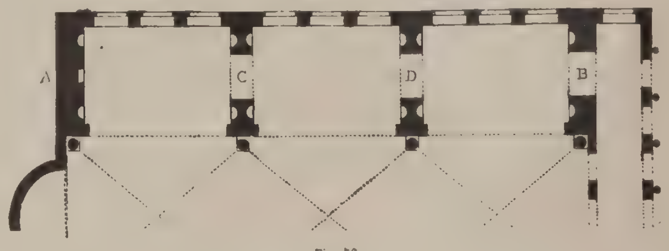
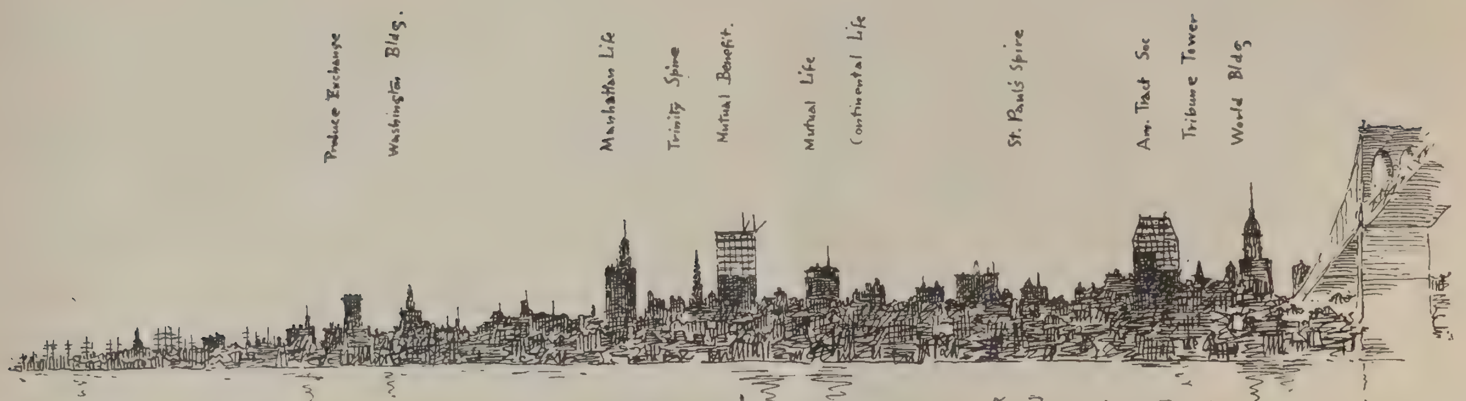


Fig. 56.

The same idea presents itself in a different form in the Basilica of Constantine. The groined vaults of the central nave had so great a span that they could not be left to themselves without the support of heavy buttresses, and for these were used the tranverse walls A, B, C, D (Fig. 56). But instead of leaving these like spurs against the piers of the great central vault, barrel vaults were carried between them, and the space thus covered in was used as a lateral aisle. They then ceased to be encumbering auxiliary works about the exterior of the edifice, and were, properly speaking, no longer works especially for support, but came under the ordinary cases where the parts of the edifice mutually buttress each other. Nevertheless, when they were free to choose, the Roman architects instinctively preferred the more simple way of exaggerating the thickness of the piers, building great cells in them, which made the increase in thickness less costly, as in the Pantheon (Plate XIII.).

(*To be continued.*)



Profile of New York from the Battery to Brooklyn Bridge

Recent Brick and Terra-Cotta Work in New York.

As we approach New York from either side, nothing could be more conspicuous than the group of overtopping office buildings that have been of late years erected. The spire of Trinity Church, that of old dominated the city, has become an unimportant obelisk, scarcely noticeable in the midst of higher and more massive blocks of outline by which it is surrounded. Each one that is newly built, outvying the earlier in height, becomes in turn the wonder of the moment. First the World Building reached an unprecedented number of stories. After that the Manhattan Life, with its sixteen stories, made the Union Trust, with its poor eleven stories, seem quite matter of course. And now people are wondering by how much, when finished, the American Surety, with already eighteen stories, and more to come, will tower above the Manhattan Life.

There are in the lower district of New York, from the Battery to Chambers Street, fifteen or twenty buildings that are ten stories or more in height; most of them twelve or thirteen, some sixteen, eighteen, or twenty.

Crossing the Brooklyn Bridge, from which the sketch at the head of this article is taken, we turn down town along Printing House Square. Passing over the World and Times buildings, which are too old to be called recent, in these railroad times, — six or seven years the youngest of them, — we enter the canyon called Nassau Street, at the mouth of which rises, on the right the Times, on the left the Tract Society's buildings. The latter, above the five stories of stone already built, gives promise of fifteen or sixteen stories more of brick and terra-cotta; but it is not yet far enough advanced to comment upon; nothing but a gaunt iron scaffolding, dark brown-red against the evening sky.

At Beekman Street we come to a very creditable effort, the Vanderbilt Building extension, a fourteen-storied, square-shouldered mass. The basement, by which I mean, not an underground story, but the architectural bottom of the design, comprising four stories, is of stone, done as properly as McKim, Mead & White, the architects, usually do things, but not brick or terra-cotta, and therefore not now to be especially spoken of.

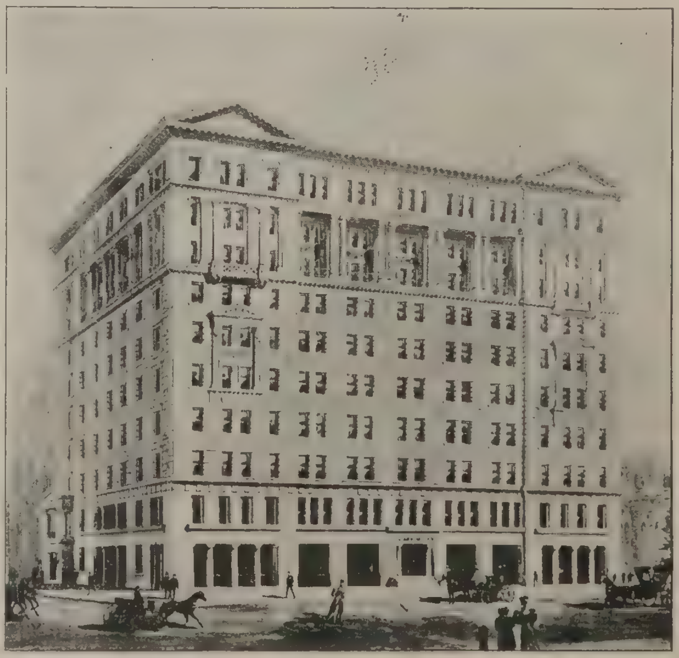
Above this come ten stories of buff brick, without anything that can be called enrichment; nothing but a treatment of brick quoining carried across the front, which is very judicious. The top stories vary somewhat. There are pilasters and capitals discernible, but they count for little at so great a height. The whole is topped by a copper cornice, not so bad as one of sanded galvanized iron, but not precisely what we should like to see there.

Following the picturesque line of Nassau Street, the most satisfactory street in New York, from an artist's standpoint, with its succession of slight hills, its sinuous course, not so sharply curved as to cut off the distant view, and the continual variation in width, after the Dutch fashion, we come to two buildings at the opposite corners of John Street, which neither challenge admiration nor need condemnation. Plain, straightforward, business buildings they are, the Prescott and the Sheldon buildings, the one ten, the other twelve stories high, of both Clinton & Russell are the architects. Simple, reasonable masses of brickwork with some slight adornment of moulded brick and terra-cotta, but not making any pretence at being works of art.

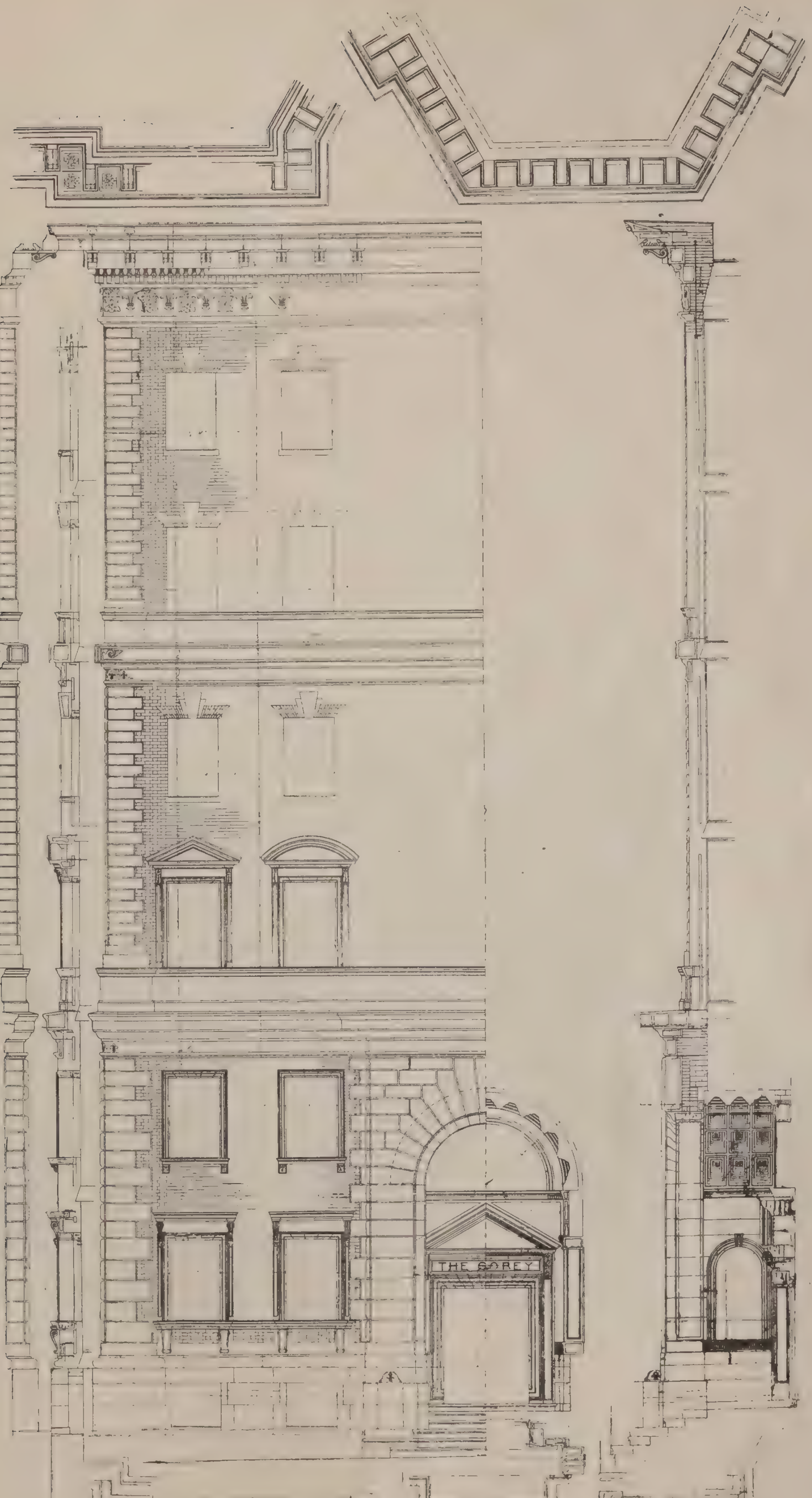
Leaving Nassau Street, we turn down Maiden Lane, and come next to the Lawyers' Title Insurance Building, done by C. C. Haight.

All of the enrichment here is in stone; the four lower stories and the three uppermost stories are entirely of stone, in very rich and massive Renaissance, the sky line being adorned with big dormers and chimneys, and peaked roofs, that are very good indeed, in their way. The middle six stories, making thirteen in all, are of light buff Roman-shaped brick, laid with the most perfect plainness of treatment conceivable, but than which there could be none more effective in this particular place. There is nothing — absolutely nothing — to these six stories but a flat brick wall with square-headed, sharp-edged window openings in twin groups of triplets. The reveals are sixteen inches deep, quite in keeping with the massive stonework below, and giving to all the buildings around, the little five and six storied ones, I mean, with their four-inch reveals, a curiously flimsy, threadpapery look, and quite overpowering a tall, twelve-story, narrow-front building near by.

A little farther along, at the crossing of Maiden Lane and William Street, we come to what I think may be considered, whether

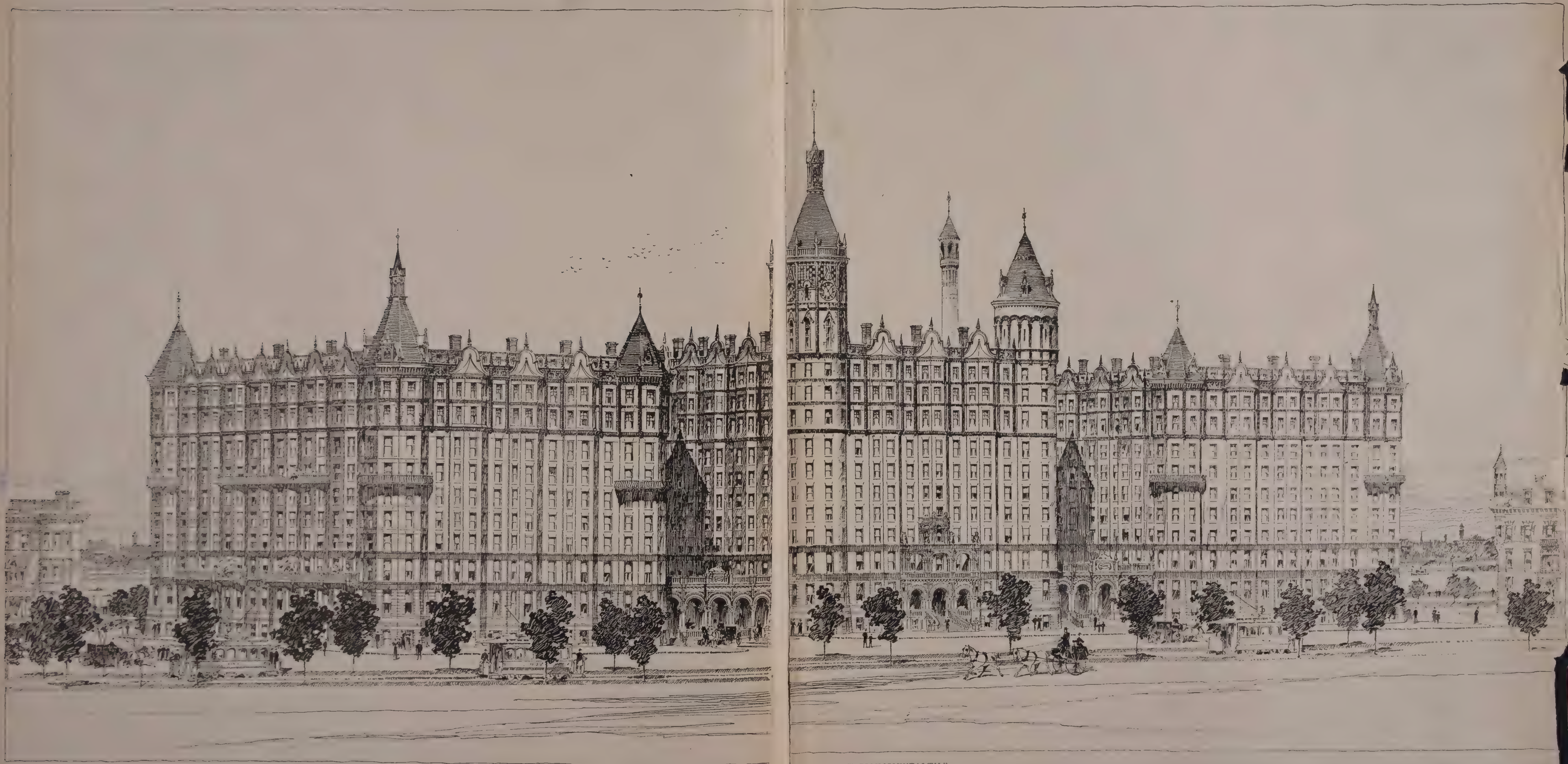


UNIVERSITY BUILDING. ALFRED ZUCKER, ARCHITECT.



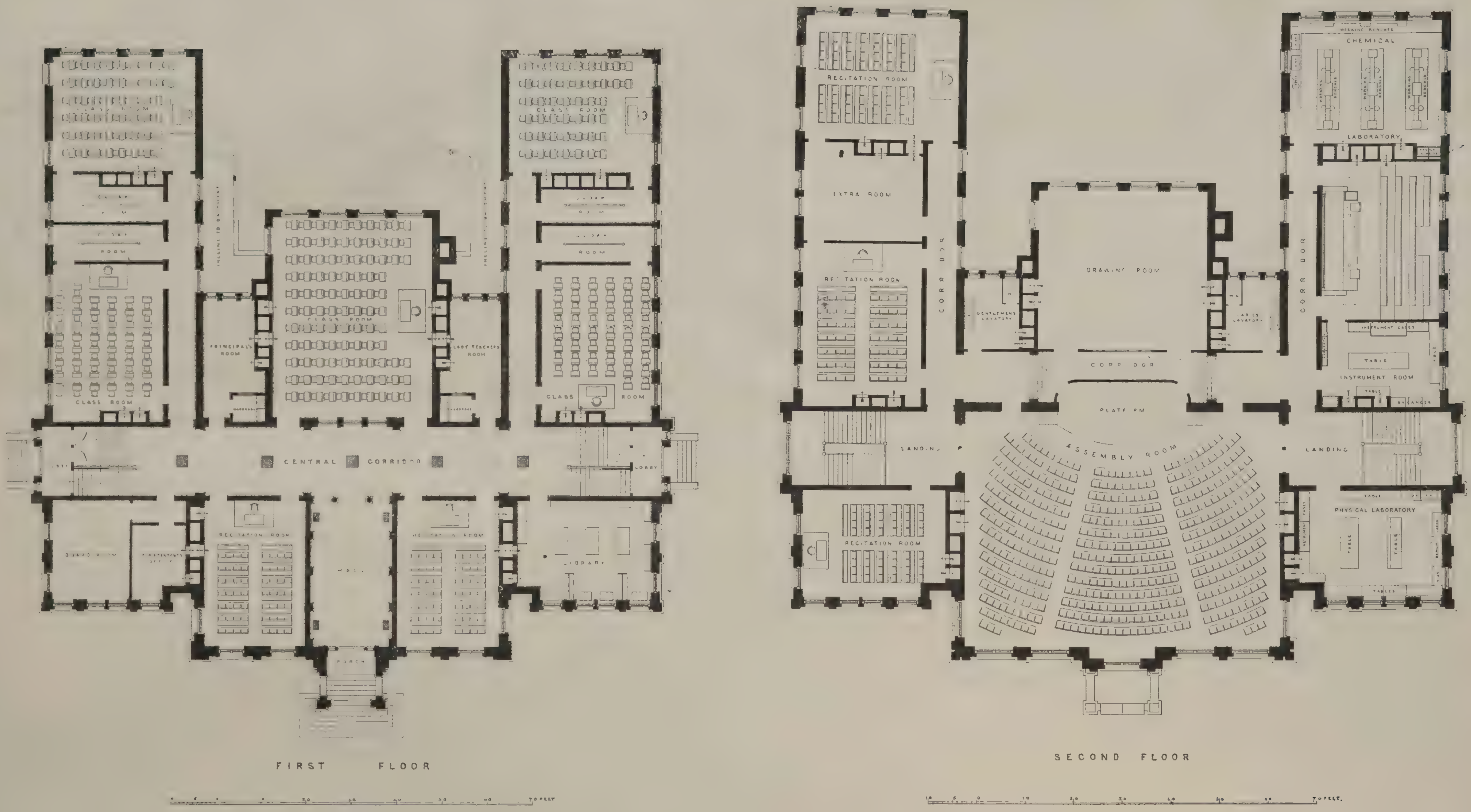
DETAIL OF APARTMENT HOUSE, BROOKLINE, MASS.

Arthur H. Bowditch, Architect.



PROPOSED NEW BACK BAY HOTEL, "THE COMMONWEALTH."

J. P. PUTNAM, ARCHITECT, BOSTON.

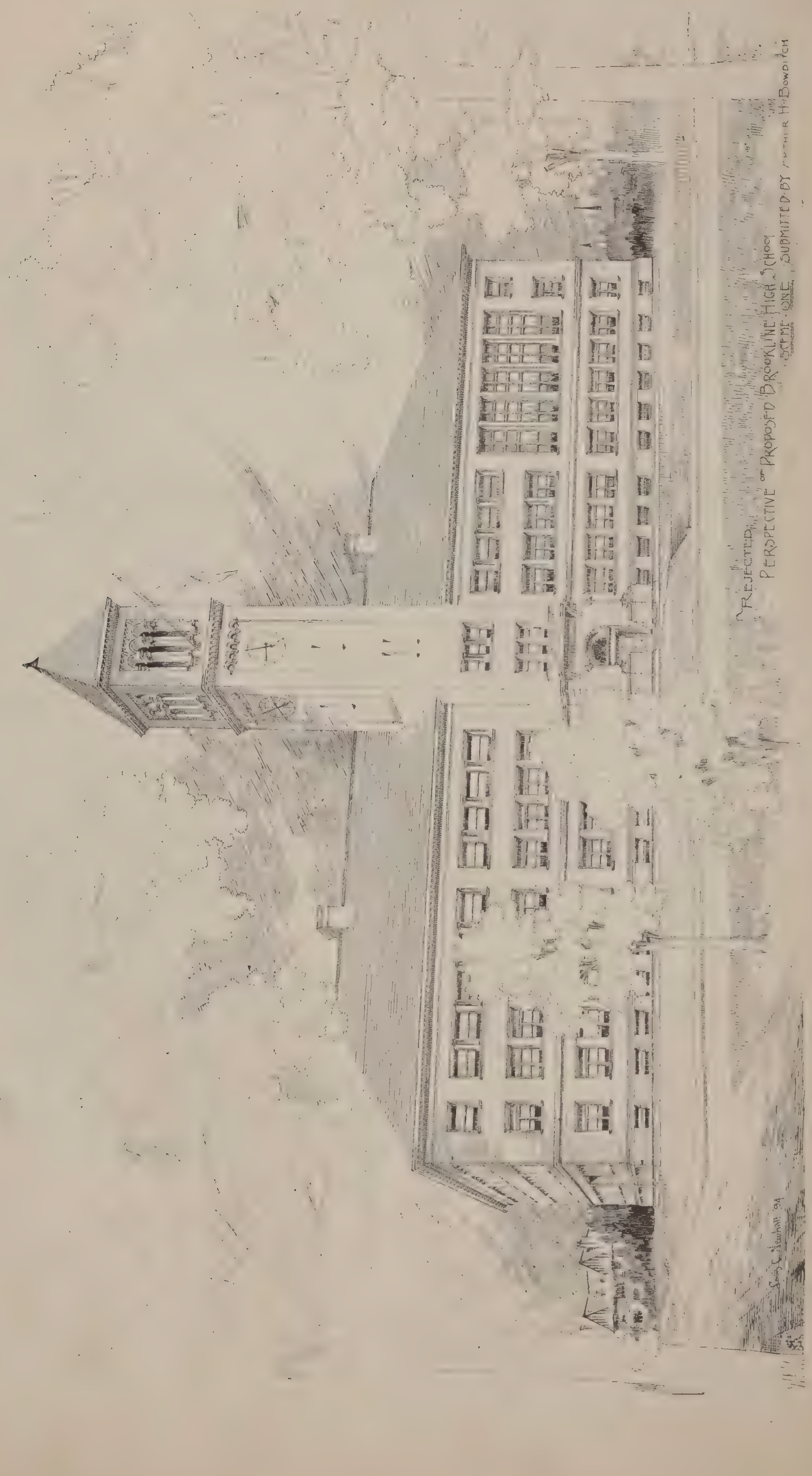


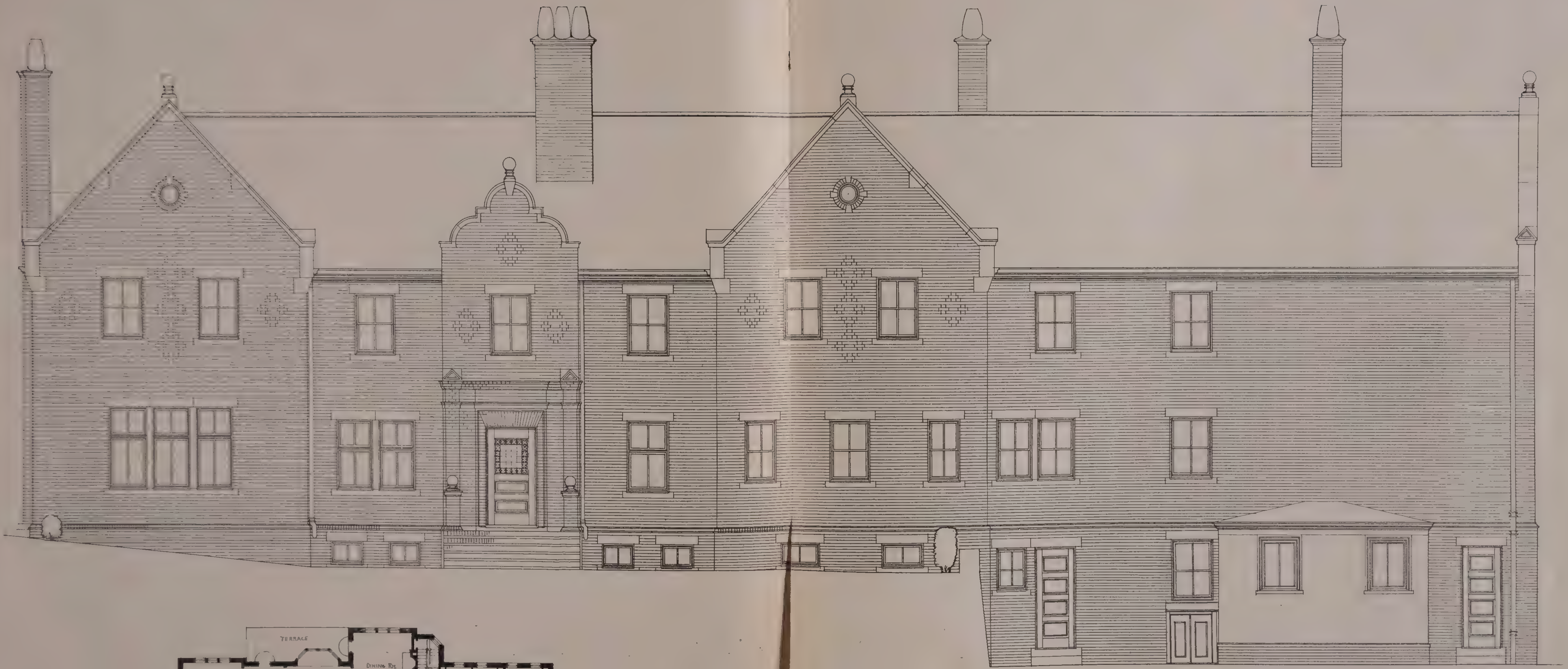
FIRST FLOOR

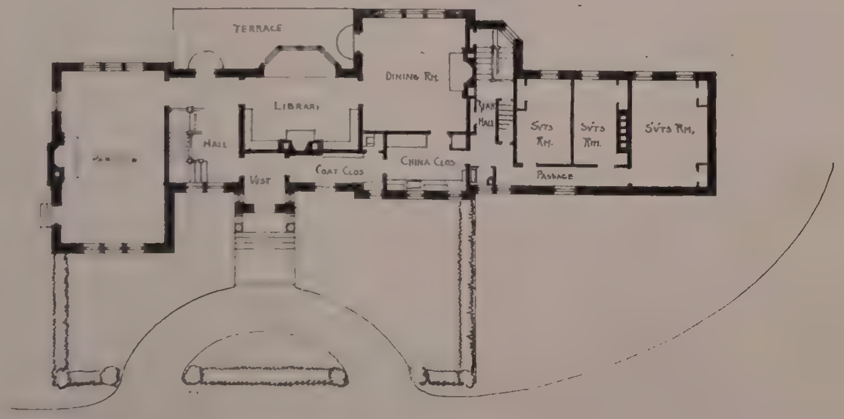
SECOND FLOOR

FLOOR PLANS PROPOSED HIGH SCHOOL, PLAINFIELD, N. J.

W. & G. AUDSLEY, ARCHITECTS.


REJECTED.
PERSPECTIVE OF PROPOSED BROOKLINE HIGH SCHOOL
SCHEME ONE. SUBMITTED BY ARTHUR H. BOWDITCH
Louis C. Newhall '94

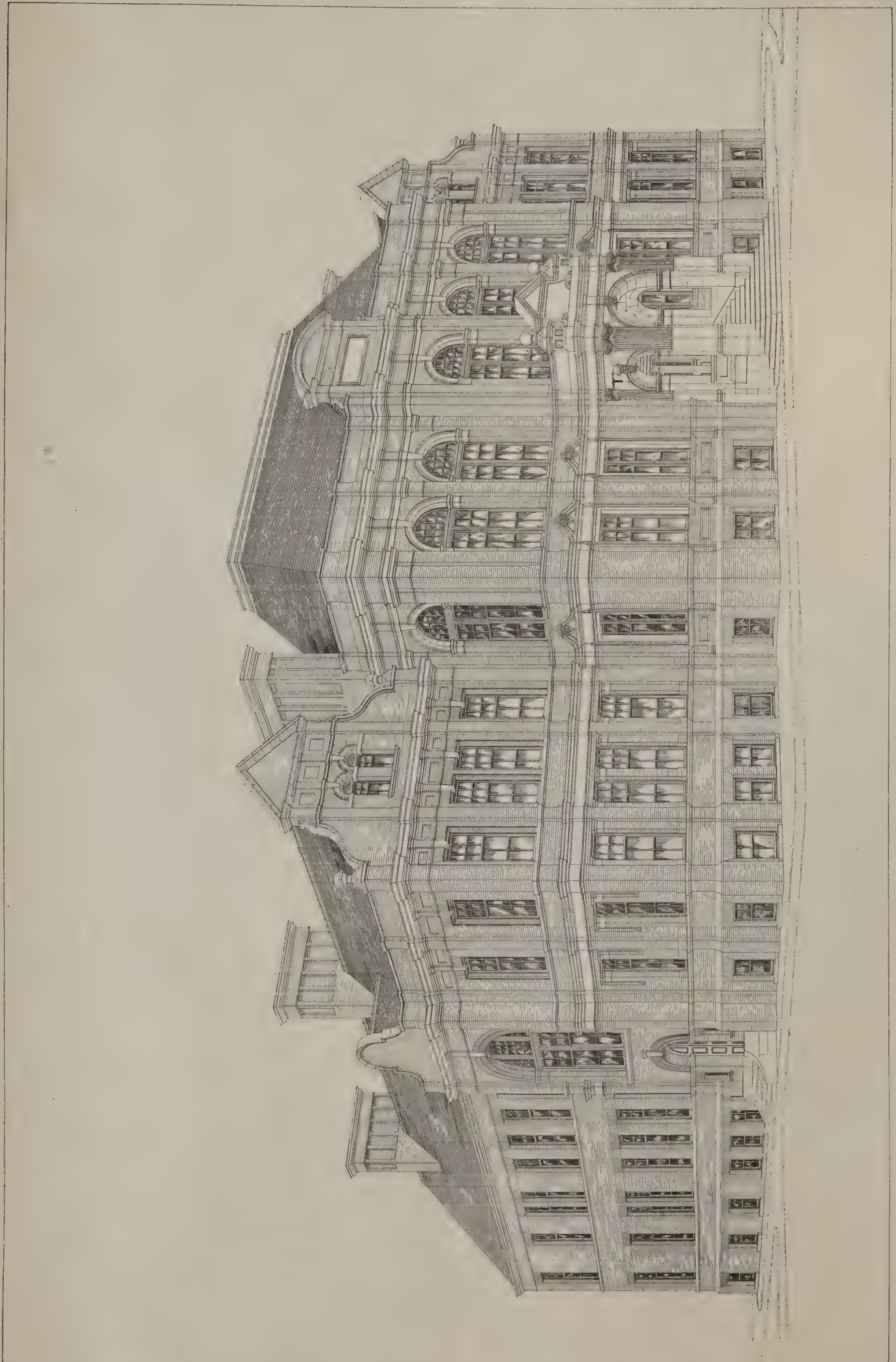




~ FIRST STORY PLAN ~

COUNTRY HOUSE FOR HENRY B. CABOT, BROOKLINE, MASS.

STURGIS & CABOT, ARCHITECTS.

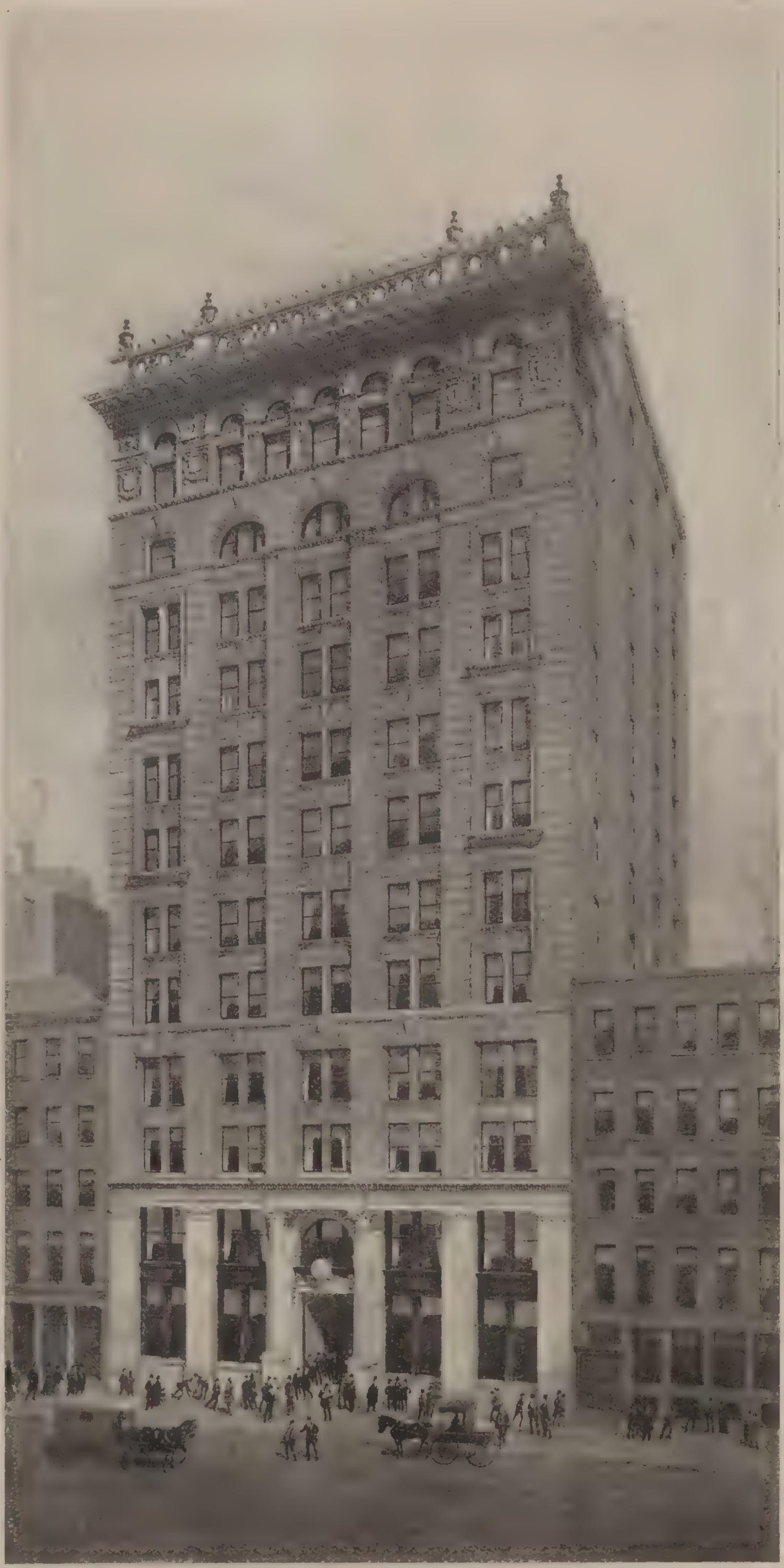


A DESIGN FOR THE PROPOSED HIGH SCHOOL, PLAINFIELD, N. J.

W. & G. AUDSLEY, ARCHITECTS, NEW YORK.

we admire it or not, the most noteworthy attempt at a design that can be found among the new steel-frame buildings anywhere.

An effort has been made, and I think successfully, at making a very tall building a really pleasing thing to look at.



CONTINENTAL INSURANCE COMPANY BUILDING.

Clinton & Russell, Architects.

It must be remembered that there is nothing that tries the power of a designer more than a very high building; most of all such high buildings as are necessarily built for modern business buildings.

When to the demand for excessive height is added an extreme restriction in the area of ground to be occupied, the problem becomes almost hopeless. What, for instance, can a designer do with such a building as the Decker Building on Union Square (to skip far up town for a moment for a suitable example)? A lot perhaps thirty feet wide, on which we must build a twelve-storied building.

A treatment can readily be devised for a tower thirty feet square, but what are we to do with flat parallel walls, running back a hundred feet or more, making our effort look like a slice of cake standing on edge with the icing decorations on the front?

Yet here at the corner of Maiden Lane and William Street, on a lot only about twenty-five by seventy-five feet, at a guess, a really picturesque building, the John Wolfe Building, has been built by the architect.

It is all of red brick with light colored stone trimmings. For the sake of THE BRICKBUILDER, we may regret that the adornments are not of terra-cotta, but the availability of plain red brick, when well used, is so well illustrated, that we can hardly do better than dwell on it for a few paragraphs.

Twelve full stories, with a cockloft added in the high-peaked roof. Twelve stories, all of red brick, with a great abundance of stone trimmings throughout, quoins, voussoirs, beltcourses, colonnettes, copings, towering upward with crowstepped gables and dormers, and balconies and bays; all most skilfully and logically worked out. The style is a free Flemish Renaissance, the rather fantastic details being apparently deliberately chosen, to give them some chance of asserting themselves at the top of and upon the sides of so great a mass; and they do assert themselves, not unduly either, but just about as they should.

The north end of the lot has one angle much too acute for good effect if the building were carried out to the extreme point of it all the way up. It has been accordingly truncated in a most skilful way, and with much careful study, — study in which I can fancy the architect must have taken much pleasure, which, indeed, should be the accompaniment of all artistic effort.

For five stories upward only a small corner is cut off, sacrificing as little floor space as possible. The corner of the sixth story is cut a little farther back, leaving the portion below as a projecting bay. This second setback reduces the narrow front to two equal faces, forming an obtuse angle with each other. As an obtuse angle is not a very happy central feature for a design, at the eleventh story the obtuse angle is itself cut back, leaving a little triangular balcony, the face formed by cutting off the angle, together with the flanking faces, standing at a slight angle with it, are all included in one large crowstepped gable, with a multitude of moulded stone copings and courses, and a much enriched semicircular tympanum over all. On the long side are large dormers, two of them, carried through two stories, and fashioned into similar picturesquely outlined gables.

There is not a better studied piece of design in New York, nor one that shows better results. The successive retreating steps where the stories set back at once give value to the height, and relieve the box-like appearance that is especially hard to avoid where there is excessive height.

But two minor points occurred to me which might be questioned. One is that perhaps the reveals of the windows have been somewhat frittered, by bevelling and by double orders, both of which are used very generally throughout; but the surface effect obtained may have been, after all, what was aimed at. The other point is that the cornice over the tenth story on the long side seems rather too strong to be quite in keeping with the perpendicularity of the rest of the building.

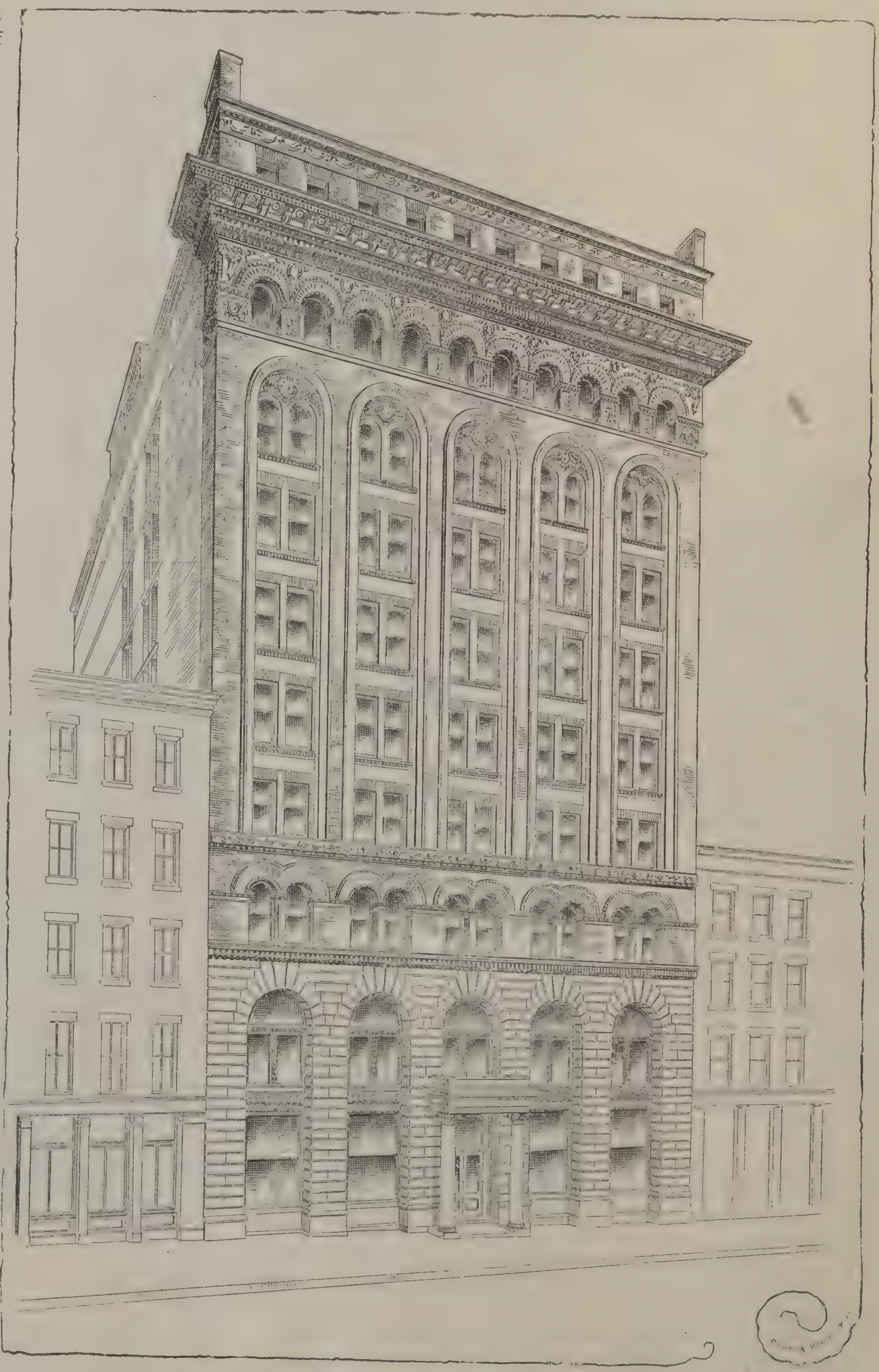
As we walk around to the rear on Liberty Street and note accidentally with pleasure an interesting carved stone heraldic beast in an odd corner, we become conscious of a dark overshadowing nightmare near by, of I know not how many stories nor by whom architected, nor would I tell if I did; so much may kindness conceal.

At a distance up the defile of Liberty Street may be discerned the sixteen stories of the rear of the recent new portion of the Mutual Life, seven stories more than the nine of the original building, and twelve stories above the unimportant five stories of adjoining ordinary everyday affairs. Only the rear of the Mutual is of brick and terra-cotta, and not worthy of much comment, except of brief commendation for the happy expedient, from an architectural point of view, of leaving out the windows next to the angles of the building, thereby achieving an effect of unwonted solidity; though I should doubt its felicity from a real-estate agent's point of view; but after all the new part is only intended to give more room, and is unavoidably an ugly mass, not deserving serious thought and clearly not intended to provoke criticism.

In Cedar Street, not far from William, we encounter the Continental Life Insurance Company's Building, by Clinton & Russell, an affair of no small pretension and considerable merit. It has the advantage of a reasonably large frontage, as frontages for high buildings are nowadays reckoned, which I should guess to be about eighty feet. At any rate, there are in the lower stories five voids, each of which contains a double opening above, and the corresponding six piers. Counting the voids at eleven feet, and the piers at four, makes about the eighty feet of front. Here again the lower stories are of stone, two of them in this case, but each of more than ordinary height, so that the two seem equivalent to three or four of the stories above. This stone treatment of the lower stories seems to be the accepted method in New York's high buildings; done, no doubt, partly because of the sense of solidity which attaches to stone, that we must admit in spite of our attachment as brickbuilders and brick admirers to brick, partly because of the sense of costliness, richness, in a word, "handsomeness," that in the popular mind, if not in the architect's, is indissolubly associated with stone.

Above the two lowest stories this Continental Life Building is all of brick and terra-cotta. White, or nearly white brick they are, of the so-called "Roman" shape,—indeed this shape seems to be generally preferred,—standing piled in great piers running through six stories, the fifth to the tenth inclusive, and uniting in a story of semicircular arches that form the eleventh story. Over this again is an arcade of smaller arches, two to each main arch below and comprising two stories, the twelfth and thirteenth, with a good terra-cotta cornice on top of all as it should be, very much enriched, as are also the arches and piers immediately below it. The main shaft of the building, if I may so term it, is rather plainly treated, with rustications formed by setting back a course of brick at every twelfth course. The third and fourth stories, I had forgotten to say, coming just above the stone basement, are also treated as belonging to the lower part and not to the shaft. A building altogether very creditable and imposing.

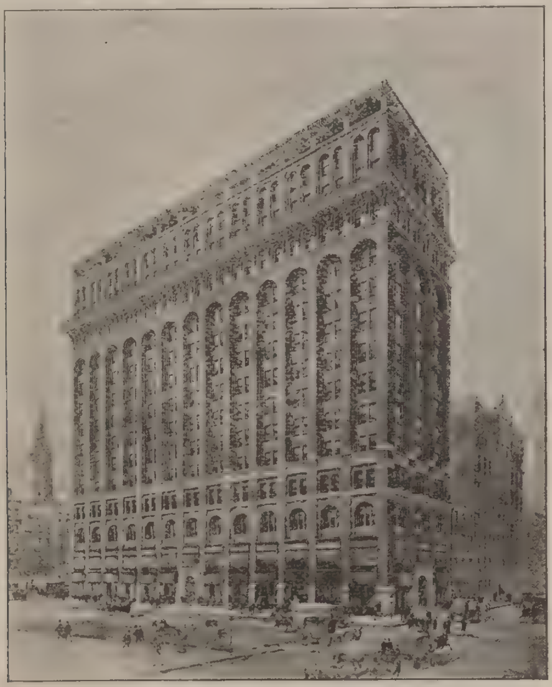
Immediately opposite, fencing up completely at this point the narrow street, is the Stokes Building, by the same architects, of very



STOKES BUILDING.
Clinton & Russell, Architects.

much the same dimensions as the Continental Life, and quite challenging comparison, being of about the same frontage, twelve stories high and of a similar disposition of the façade horizontally in five main arches, each containing two windows above the lower stories. Here again the first three stories are of stone treated in simple channelled quoins which follow down the lines of the voussoirs of the arches that form the third story. Above again it is all brick and terra-cotta, but this time a warm brown brick, much more grateful to the eye than the buff brick, but no doubt sadly darkening the streets if universally used. Again we have a story of the brickwork made part of the base of the main piers above, with a very well done terra-cotta anthemion ornament stringcourse. Still again we have comparatively plain massive piers through four stories more, their arches comprising the next and ninth story, and then a very rich tenth story arcade and cornice, and in this case a two-storied attic.

Designed, evidently, by as scholarly a hand as did the Continental Building, except, perhaps, the attic above the cornice, yet this last is accepted by so many able designers that we must not be too hard upon it, although it never seems quite right; yet, as a whole, the building, in the indescribable sympathy of the mind that it produces, far surpasses the colder charm of its neighbor opposite. But good by to it now; there are a few more that we must at least mention.



HAVEMEYER BUILDING.
George Post, Architect.

Many of the most noteworthy buildings have the fronts all of stone, and are consequently not to be discussed by us. Brick and baked clay are alone our theme. Some of them, however, have frontages upon a back street which are done in brick, showing how excellently brickwork will stand comparison with stonework. One of such is the Manhattan Life, on lower Broadway, backing up on New Street; Kimball & Thompson, the architects. The New Street front is entirely brick and terra-cotta, gray in color, a very pleasant color it is too, very good in design, and running skyward nineteen or twenty or perhaps even more stories, I got tired of counting them and continually discovering extra ones that a casual stringcourse of eight inches' projection had quite concealed, owing to the foreshortening from a nearby standpoint.

The terra-cotta detail of this building is particularly good, although it impressed me as somewhat too profuse, and too evenly distributed, although that again may have been the effect of the foreshortening; when I have a chance I shall get on the roof of the ten-story building opposite, that I may view it to better advantage at the middle of its height.

Adjoining the Manhattan Life is the Union Trust Building, also with a brick front on New Street, which, in its day, was reckoned a very high building, with its ten or twelve stories, but is little to brag of as far as height is concerned, alongside of its nineteen or twenty-storied neighbor. As to other matters than height though, it is much to brag of. I have heard it counted by those who know, and I am inclined to count it myself, as the best office building that Mr. George B. Post, the architect, ever did, perhaps the best that anybody ever did. In symmetry, in the simplicity of its triple division, it excels the Times Building, by the same architect. It is in the same style as the Times Building, but the detail is not at all equal in freedom to that of the latter.

There are other brick office buildings, a plenty, but for the present we have had about enough, and certainly the best of them. I regret only that the limitations forbid any mention of stone front office buildings. Of these latter there are two, the Postal Telegraph and Home Life, that stand alongside of each other, much to each other's detriment, but illustrating an interesting point,—the comparative merits of the cornice and the broken-line steep-roof termination. The latter I am disposed to favor. The cornice, never very logical outside of Greek usage, Michael Angelo and the Italian palaces notwithstanding, seems especially unfortunate as a termination to a building of a couple of hundred feet or more in height.

There is no reason why the top should not be made the best part of a high building, used, for example, somewhat as the dome of the World Building is used, as the office of the company owning the building, with the advantage of light and air on all sides that cannot be cut off, and a roof-garden too, if that is desired, or a series of such in terraces.

Such an arrangement is susceptible of adaptation to many purposes. If not all the offices of a company, at least the president's or directors' rooms might be so placed; or the restaurant, which is often in the top of high buildings, might be surrounded by a delightful open-air summer garden.

John Beverley Robinson.

(*To be continued.*)

A DESIGN FOR THE PROPOSED HIGH SCHOOL, PLAINFIELD, N. J.

By W. & G. Audsley, Architects, New York.

(*See Plates* 31, 32.)

THE style of architecture selected is one well adapted for a building of a public character, in which brickwork and terra-cotta are to be used.

The façade is treated in a symmetrical manner, having the main block, which contains the principal entrance and the assembly-room, advanced so as to form a leading feature in the design. This is of greater height than the rest of the building, owing to the necessity for a high ceiling in the spacious assembly-room on the second floor. The principal entrance is in the form of a projecting open porch, to which an effective character has been given by the use of simple and appropriate architectural features in strict harmony with the style and general treatment of the building. Flanking the central block are the gables of the side wings of the building, set back so as to give additional prominence to the central portion, and treated with due regard to architectural effect. These wings are of sufficient height to meet the demands of the basement, first floor, and second floor. The sides of these wings are designed in a simple but consistent manner, being relieved by the important lateral entrances to the building.

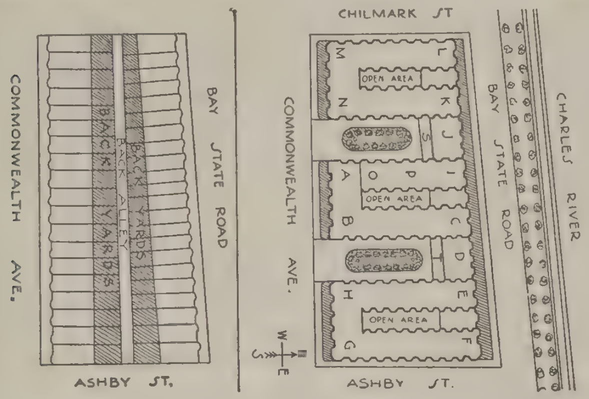
Throughout the design due regard has been paid to economy of material and skilled labor. Architectural effect has been secured by proper proportion and grouping of simple features, producing marked contrasts of light and shade, rather than by rich and expensive details and ornamentation. The maximum of architectural effect has been sought for with the minimum of expenditure.

The arrangement of the interior is thoroughly convenient, and the most perfect system of ventilation is introduced. In this design all the accommodation stipulated by the School Board has been carefully and fully furnished.

THE COMMONWEALTH HOTEL, BOSTON, J. P. PUTNAM, ARCHITECT.

THIS building, on the Riverbank lands between Ashby and Chilmark Streets, with a frontage on Charles River on the north and Commonwealth Avenue on the south, will consist of three pavilions extending from the river front to Commonwealth Avenue.

The three pavilions are separated by open courts seventy feet wide each, protected on the north by the one-story dining-room, connecting wings and affording sheltered carriage entrances on the south.



The central pavilion contains the main office and reception-rooms. The office commands a view of all the guests' entrances, four in number, of the entire hotel.

Each wing has a smaller open court thirty-five feet wide in its centre, making five open courts in all. The three smaller courts are open to the river on the north, the dining-room only being carried up at these points. Thus every suite has a view both of the river and of Commonwealth Avenue, and also direct sunlight, and every room has a view of either the river or Commonwealth Avenue or both, except some of those on the first floor.

All three pavillions are eleven stories high or 125 feet, the height limited by the building laws of Boston, excepting the towers, which are allowed to exceed this limit under special provisions as to their construction and use. In the central pavilion the eleventh story is treated differently from that of the two other pavilions for architectural effect and to provide retired rooms in the two end pavilions for the service, not visible from Commonwealth Avenue, except at a great distance from the building.

The open courts and entrance portico and arcades furnish the elements for producing a rich effect of light and shade, and considerable picturesqueness without loss of simplicity and dignity. The materials proposed for the façades are dark red terra-cotta enrichments on a body of buff or warm gray brick with a darker buff for the basement and first story. The style and coloring have been suggested by the very beautiful palace of the Grand Duke of Mecklenburg-Schwerin in North Germany. The effect is extremely rich without being costly, the warmth of color of the materials contrasting admirably with the cold grays and blues of the sky and river, and with the foliage in Commonwealth Avenue, in the courtyards and the river park laid out by the landscape gardeners of the Charlesbank.

The arrangement of the suites is somewhat novel, particularly as to elevator service. There are in all twenty-one elevators in the building, so placed that each suite shall be served by one, and in case two suites are united to form a single large suite, one of the elevators forms a front and the other a rear or service elevator. In other words, all the large suites are served by two elevators, and these large suites are so designed that they may be divided at any time in the future into two or three suites.

In virtue of this treatment of the elevators, it has been possible to avoid the usual waste of room occasioned by long passageways, the extra elevators much more than paying for themselves in this economy of space. All the large suites are arranged in tiers from second floor to top story, so that the elevators shall all be used for the same service in any teir of rooms. Each suite is provided by one or more bathrooms, and each bathroom by an ample and well-lighted dressing-room in the rear of the bathroom and separated therefrom by leaded cathedral or fluted glass partitions. The arrangement of other matters and details of the suites and of the managing and serving rooms, kitchen, storerooms, lighting, heating, ventilating, mailing plants, etc., and of the fireproof construction, are being carefully studied out by a specialist in hotel and apartment-house construction of twenty-four years' experience.

Particularly favorable opportunity is furnished by the conditions of the site for the convenient handling and storage of provisions, and for the handling and transportation of baggage and furniture, all stores and furniture being conveyed on small cars running on tracks from the basement service entrance on the side street directly to the elevators in the basement and thence to their destinations without leaving the small cars or trucks until they are deposited in their proper places in the rooms for which they are intended. The elevators and passageways are everywhere made capacious enough to take the largest pieces of furniture without crowding. A very large boiler and ventilating chimney, constructed to take away entirely all odors of the kitchen and other service-rooms, is shown in the perspective and forms an ornamental feature in the design.

Each pavilion shows a different arrangement of rooms in the suites, and different forms and sizes of suites, some housekeeping and some non-housekeeping, the housekeeping suites being arranged to be convertible into non-housekeeping, and *vice versa*.

A one-story grand ballroom, between the banquet hall and the reception-rooms and parlors, is shown in the central pavilion. As previously stated, it is proposed to build only a part of the structure the first year, and add to it from year to year as the demand justifies.

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ANY draughtsman out of employment, who will send us his full address and answer the following questions: —

By whom were you last employed?
Can you furnish good recommendations from your last employer?
On what particular line of work have you been engaged?
What salary do you expect to receive?
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may have his name placed in our Exchange Bureau, and will be notified of any parties desiring his services as a draughtsman.

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WE call your attention to the forgoing announcement, and upon your application would be pleased to put you in communication with any draughtsman whom we think would meet your requirements. All communications will be regarded as confidential, and no charge will be made.

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We would like to arrange with a draughtsman in each of the following cities to furnish us with a monthly letter which shall be a review of the important building being done or contemplated in their respective cities: New York, Brooklyn, Buffalo, Cincinnati, Pittsburgh, Indianapolis, and St. Louis. Address, The Brickbuilder Publishing Company, Boston.

THE BRICKBUILDER.

AN ILLUSTRATED MONTHLY DEVOTED TO THE ADVANCEMENT OF ARCHITECTURE IN MATERIALS OF CLAY.

PUBLISHED BY

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COLOR IN BRICK AND TERRA-COTTA ARCHITECTURE.

IT must be admitted that the question of color in architecture is one which is worthy the most careful study of our ablest architects. That it has received such study we all know, and yet there appears to be a hesitancy on their part to launch out upon the ocean of possibility which now lies before them in the direction of the use of special colors in brick and terra-cotta.

Within the past ten years a great impetus has been given to the production and use of special colors in architectural clay products. Ten years ago fully four fifths of the terra-cotta produced was red. Now, hardly one fifth is of that color. Buffs and grays of several shades, white and cream-white, and the richer, warmer colors of the fire-flashed old gold and mottled have come, and have evidently come to stay.

Of the same colors are the bricks, in unique and graceful forms, heretofore unknown among us, giving the architects much greater opportunity in the display of artistic taste than has ever before been enjoyed by the profession.

It may be said that our architects do not pretend to be color artists. That may be, but many of them are color artists of the highest order, and to these a great opportunity is given by our modern brick and terra-cotta manufacturers in the great variety of soft, natural colors which are now produced.

Messrs. Blackall & Newton, of Boston, have taken a step in the right direction in the treatment of the new Tremont Temple. The terra-cotta blocks of varying colors are very effective, and the success of this effort should encourage others in the same direction. Every one is familiar with the beauty of seam-faced granite. Take your stand, for instance, in Copley Square, where you have a good view of the New Old South Church, note the varying colors. Where would be the beauty if every stone was identical in shade, and yet the contrast is very great? It is only when taken *en masse*, and the colors blend together in a soft harmony of tone, that its real beauty is seen. Such effects can be produced in bricks, the sizes, twelve by one and one half inches, being especially well suited for this, as the fine lines of color blend more perfectly, and produce an effect most pleasing to the eye. Looking at such a building a short time ago, a business man remarked, "I do not know what it is about that building, but the more I see of it the better I like it. It has made such an impression upon me, that sometimes in the night when I am wakeful I call to mind its graceful lines and the blending of the colors of the brick, and I drop off to sleep."

I would like some architect to tell me whether he should consider such a remark a compliment or otherwise. I am sure there are some buildings so remarkable in form and color as to produce in the mind of the innocent beholder such a feeling of unrest and dissatisfaction as effectually to prevent sleep.

The advent of this class of brickwork has brought out many interesting discussions among architects, builders, and owners, and the history of some of the buildings, where they have been used, has been at times even exciting. Let us take a typical case. A syndicate is to erect a large business block. The building committee and the architects send out for samples of different bricks. These are spread upon a table and are considered by the committee. A brick of certain color is finally agreed upon, and while it may be said by some one present that the bricks will not all run of an even shade, yet quite likely the members of the committee will not fully appreciate this fact, and will really expect to get a brick almost identical with the shade of the one selected. The order is given to the brick manufacturer, who begins to deliver the goods. All at once a great cry is raised by the committee: "These bricks will not do at all. Our building will look like a checkerboard with such a variety of shades." It is explained that when these bricks are set in the wall, the disparity of shade, so apparent when only two bricks are compared, will largely disappear, and when seen *en masse* the colors will blend, producing a most pleasing effect. But the committee know better: "You need not tell us any such plausible story. Our building will be spoiled by the use of such brick as these. They must be taken away. Look at Mr. John Smith's building. What a fine looking front! We do not propose that ours shall be less beautiful and effective than that." "Well," says the brick manufacturer, "will you be satisfied with as even a shade as in the building you mention?" "Why, certainly," is the reply. "That is just what we want." The manufacturer then selects, from the pile of bricks before them, two of the extreme shades of color, and asks the committee to go with him to John Smith's building. They do so. The committee stands on the sidewalk opposite, while the manufacturer proceeds to the second or third story window, and holding the two bricks out against the wall, shows the committee, much to their surprise, that the contrast there is fully as great as in their own bricks. Still they are sceptical, and decide, against the advice of the manufacturer, and probably of the architect, to cull the bricks, taking the medium color for the front, and putting the extreme shades on the sides or rear. The consequence is that when the building is completed, pointed and cleaned down, it is found and admitted by all that the sides and rear, where the "culls" were used, are the handsomest parts of the whole. The above has been substantially the history of scores of buildings, and is only mentioned to show that the untrained eye cannot judge by the appearance of two bricks what the effect will be when seen *en masse*.

A very important point, however, in the use of varying shades of brick is that of having them evenly distributed in the wall. If either the light or dark shades are "bunched," the effect is very bad. Indeed it could not well be worse, and before this fact was fully appreciated, some buildings were erected which present a very unsightly appearance.

A splendid opportunity for the use of color with fine effect lies in the direction of pattern work for frieze, band course, or any plain surface. Right in this line were the illustrations in the issues of THE BRICKBUILDER for November and December, 1894. In the March issue also, in the article by Mr. Wyatt, on page 55, this idea is elaborated, and two exceedingly interesting cuts are displayed; one showing the chimneys of the Bryn Mawr School, and the other, a bit of the cornice and frieze of the Arundel apartments. I hope these will stimulate our architects to take up this very interesting and I am sure practical method of ornamentation of brick fronts at very little expense.

A good illustration of color effect in brick and terra-cotta is to be seen in the tower of the Mechanics' Building on Huntington Avenue.

With its dark red brick and light red terra-cotta, the effect is most pleasing. In the Art Museum, on Copley Square, is an illustration, perhaps, of the danger attending the use of several colors. The sharp contrasts there are not pleasing, and perhaps it is because of this danger that so few architects are seeking to produce the fine color effects which are possible with the bricks which are now in the market.

Perhaps the statement that our architects seem loath to branch out boldly into this field should be somewhat qualified. They seem now to be awakening to its possibilities. In New York City and Philadelphia especially there has been a great impetus given to the use of fire-flashed bricks and terra-cotta, and beautiful effects in old gold and mottled work have been attained. It may be interesting to note that in New York City are several old brick buildings which have been painted in imitation of varying colors of fire-flashed bricks.

But resort to the paint brush for color effects in brick is entirely out of place, and should not be tolerated. The natural colors now produced offer the widest field, and the next few years will doubtless show some interesting and beautiful color effects in the use of architectural clay products.

George M. Fiske.

BRICKBUILDER COMPETITIONS.

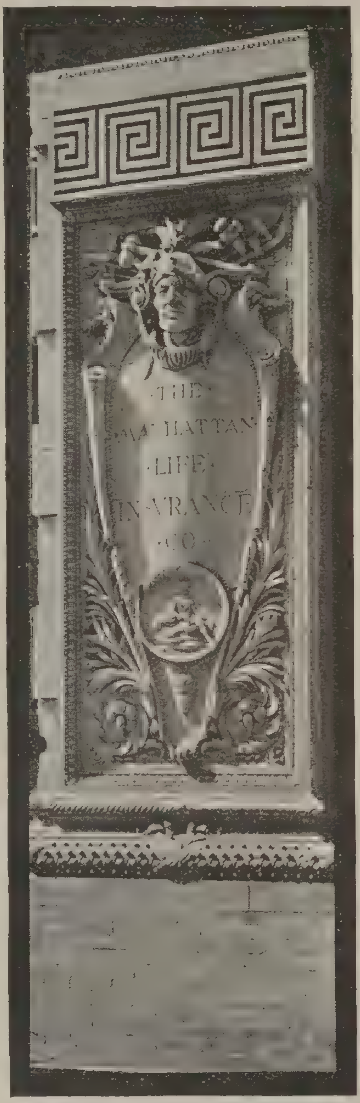
Program.

We desire to announce a competition open to all draughtsmen who are subscribers to The Brickbuilder, for a city house of brick. The house is to have a frontage of twenty-five feet on the street. The lot is eighty feet deep. The house will have four stories over the basement, and its cost must not exceed $16,000. The front will be of brick, with architectural detail of moulded pressed brick, taken from the catalogues of our advertisers, or of pressed brick and terra-cotta; colored faience may be introduced into the ornamentation if desired. The drawings will be made in line with black ink, on two sheets, cut to the uniform size of 14″ x 18″. One sheet will show the elevation at a scale of one fourth inch to the foot; the other, the plans of the first and second floors at a scale of one eighth inch to the foot; and details of the façade (especially the cornice) at a scale of one half inch to the foot. The style of brick bond adopted must be clearly shown on the elevation. Drawings must be received at the office of The Brickbuilder not later than the first day of June. The Brickbuilder offers a first prize of $60, a second prize of $40, and a third prize of $20. In addition to these prizes, The Brickbuilder offers a special prize of $40 for that design, *accompanied by specifications*, for a similar brick house, of fireproof construction throughout, which can be executed at the lowest cost. In awarding this special prize, only those designs will be admitted to competition which reach a certain standard of excellence in design; but beyond that, the awarding of the prize will depend on the excellence and the economy of the construction called for in the specifications. Designs unaccompanied by specifications will be regarded as being entered only for competition for the first three prizes. This special prize may be taken by one of the winners of the other prizes, or by another, as the case may be. The question of cost will be submitted to an expert builder. The prizes will be awarded by a jury of three architects of acknowledged reputation.

Each drawing must be marked with a motto or cipher, and a sealed envelope similarly marked, containing the full name and address of the designer, must accompany the drawings. These envelopes will not be opened until after the award is made.

The Brickbuilder reserves the right to publish the prize designs and the prize specification. Other drawings may be published with the permission of their authors. At the conclusion of the competition all drawings will be returned to competitors. Drawings must be delivered flat, express or postage prepaid.

OUR ILLUSTRATED ADVERTISEMENTS.



The illustration in the advertisement of The Hydraulic Press Brick Company (see page xix) is a view of the church of Santa Fosca on the island of Torcello near Venice. Torcello was once one of the important towns of the Venetian lagoons. Now these buildings, standing alone among gardens and orchards, are all that remain of a city that was important before the present Venice existed.

The basilica was once the cathedral of Torcello. Both churches are even more interesting within than without, and the basilica contains some magnificent early mosaics. Both are of brick with marble columns used in the colonnades. They date from the eighth century of art era.

The Atwood Faience Company (see page xvii) illustrates this month one of the beautiful pieces of decorated faience by Luca della Robbia which forms part of the decoration of the chapel of the Pazzi family, a charming little building which stands close to the great church of Santa Croce in Florence.

A portion of the new street elevation of the Manhattan Life Insurance building is illustrated in the advertisement of the New York Architectural Terra-Cotta Company (see page xviii). The accompanying illustration of a decorative panel on a pilaster gives an idea of the elaborately designed and beautifully moulded terra-cotta detail.

The annual loss by fire in the United States has become appalling. The debt entailed upon the country by the war of the Revolution was $75,000,000; by the war of 1812 the debt was $85,000,000. Yet at the present day the people of the United States are annually burning up every year more property than was consumed in either of these wars. And, since the close of the Rebellion, the aggregate loss by fire in the United States is larger than the whole amount of the expenditures made by the North to put down that gigantic rebellion. These are appalling figures, and they must lead to appalling conclusions.

The Tiffany Pressed Brick Company announces a removal on the 1st of May to suite 1149–1151 new Marquette Building, where, besides showing their usual fine samples of plain and ornamental pressed brick, they can point to the entire "Marquette" court, which is faced to its sixteenth story with Tiffany enamelled brick. The Tiffany is retaining its trade in high-trade pressed brick, and is securing large contracts throughout the country for enamelled brick, which are being turned out in shapes and colors to suit the demands of architects and owners.

The Garry Iron and Steel Roofing Company, of Cleveland, are just finishing the last iron building for the United Salt Company of Cleveland, Ohio.

Fireproofing Department.

Conducted in the Interests of Building Construction to Prevent Loss by Fire.

BUILDING CONSTRUCTION IN ITS RELATION TO FIRE PROTECTION.

(From the *Canadian Architect and Builder*.)

THE large fire which caused such destruction to buildings in one of the principal parts of Toronto last month made reasonably clear that the series of conflagrations by which Toronto has been visited of late were due to incendiarism. It can hardly be conceived, in the light of the immunity which the city enjoyed for so many years, that three such conflagrations should take place within so short a period from accidental causes. It has been the subject of comment that in each instance the fires originated in buildings situated in the very heart of the business district of the city, where there was a reasonable certainty of their being rebuilt. It is to be hoped that the reward of $1,000 offered by the Underwriters' Association for the conviction of the incendiaries will have the desired result.

The rapid destruction of Mr. Robert Simpson's new departmental store building, an illustration of which appeared in the January number of the *Canadian Architect and Builder*, and which was among the first of the buildings erected on the modern iron construction principle, not only demonstrated the insufficiency of the city's fire equipment, but what is more important, the fact, that so long as the prevailing methods of building are allowed to continue, the most effective fire-extinguishing appliances will be of little avail in preventing the spread of fire when once it shall have obtained hold upon a building. If a merchant wants a building put up with the greatest amount of floor space and with street fronts almost entirely of plate glass, his architect may advise him of the danger to which it will be exposed from fire, and that it will also be a menace to the safety of surrounding buildings; but if the proprietor refuse to go to the expense of making the building fireproof and be willing to assume the risk of having it destroyed, the architect can do no other than carry out his wishes. It is here that the law should step in and prevent the erection of structures of such a character. Since the recent fire, a clause has been discovered in the existing building by-law of the city, limiting the floor areas of buildings and providing other safeguards against fire. Strange to say, this clause has been more honored in the breach than in the observance. It reads as follows:—

"No block of warehouses or storehouses or other buildings (except churches, public halls, and opera houses) shall contain more than forty squares of building on the ground floor thereof, including internal and external, and half the party walls belonging thereto, unless such building be separated and divided by party walls into divisions of not more than forty squares of building as aforesaid, unless the permission of the city council shall be first obtained. No block of warehouses or other buildings shall communicate with any other block of warehouses or other buildings through a party wall, nor shall any stable communicate with any other stable through a party wall, unless the door case and sill of every such communication be of stone or wood covered with tin, and unless there be to every such communication a door of two thicknesses of wood covered on both sides with tin. No timber bond or lintel shall be laid into the brickwork of any wall in any such building nearer than eighteen inches to the opening of such communication, unless the door case and sill of every such communication be of stone or of wood cased with tin."

The committee appointed by the Ontario Association of Architects to recommend to the city council needed amendments to the city building by-law have lost no time in dealing with the subject. Since their appointment the committee have held eight meetings, at which the building ordinances of London, England, New York, Chicago, St. Louis, and a number of other cities have been carefully considered, together with other data bearing on the subject in hand. As the result of their deliberations the committee have framed a by-law which will be recommended to the city council at an early date. In view, however, of the unusual circumstances at present prevailing in the city, and the urgent necessity for immediate legislation to prevent the erection of buildings constructed in a manner similar to those recently destroyed, the committee have recommended that the following provisions be at once incorporated into the existing by-law:—

"FIREPROOF BUILDINGS.— Every building hereafter erected, which belongs to the public building class or the hotel class, the highest occupied floor of which exceeds 50 feet in height from the average ground line, and every building hereafter erected belonging to any other class, the highest occupied floor of which exceeds 70 feet in height from the average ground line, shall be built fireproof; that is to say:

"It shall be constructed with walls of brick, stone, or terra-cotta, or other hard, incombustible materials. No wooden beams, lintels, bond timber or wood strips shall be built in walls.

"The floors and roofs shall be constructed of brick or terra-cotta arches or other hard, incombustible material, and the supporting beams shall be of steel or iron, all properly cased with non-combustible material.

"The stairs and staircase landings shall be built of hard, incombustible materials.

"No woodwork or other inflammable material shall be used, excepting the floor boards, the doors and windows and their frames, and the trims, casings and interior finish, when filled solid at the back with fireproof material. The exposed parts of all constructional steel and iron work, supporting walls, floors, roof or stairs, shall be efficiently protected with at least two inches of porous terra-cotta; or, where such is not feasible, with wire lath and plastering of sufficient thickness.

"No existing non-fireproof building shall be converted to the purposes of a building of the public building or hotel classes, the highest occupied floor of which exceeds 50 feet from the average ground line, and no existing non-fireproof building shall be increased in height to exceed the limits set forth in this section for new buildings of the same class.

"But nothing in this section shall prevent the erection of what are known as grain elevators as usually constructed, provided they are erected on the water front in isolated localities, and under such conditions as the inspector of buildings may deem prudent.

"ELEVATORS. — Where elevators are enclosed in shafts, all the enclosing walls must be built of brick or terra-cotta or other incombustible material.

"In all buildings of the manufactory class that are more than two stories in height above basement, and in all buildings of the store and warehouse class that are more than three stories in height above basement, the elevators must be enclosed in shafts built of brick or terra-cotta, and extending at least three feet above roof, and covered with a light glass skylight or easily broken covering; and all the doorways opening into such shafts shall be closed by iron doors, or else by doors of two thicknesses of solid boards covered all over with asbestos and sheet metal.

"Where elevator shafts cannot conveniently run to top story and from thence out to roof, the top of shaft must be covered with a fireproof ceiling.

"Where elevators are open, the guide posts and corner posts must be of iron, and any inclosing screens must be of incombustible material. No woodwork of any kind, other than strips on cage guide posts, shall be carried from floor to floor.

"FLOOR AREA. — No building hereafter erected (except public audience rooms) shall have on any floor thereof more than four thousand square feet of floor area undivided by division walls. Nor shall the undivided floor area of any floor in any existing building (except public audience rooms) be increased so as to contain more than four thousand square feet.

"Division walls to divide the floor area of a building into spaces of not more than four thousand square feet must be of stone, brick, or terra-cotta.

"Door or other openings through division walls must not exceed in their united width one third the length of wall.

"All openings through division or party walls shall have tight-fitting doors and frames of iron; or else, if of wood, constructed of two thicknesses of solid boards, and covered with asbestos and sheet metal.

"Each section of floor area divided from the rest of building by division walls and fire-resisting doors shall have a separate stair and exit to street.

"All fireproof buildings, built as described for fireproof buildings under section . . . of this by-law, shall be exempt from the restrictions as to floor area.

"PROTECTING STRUCTURAL IRON WORK. — All metal columns and beams supporting walls, except first floor and basement columns on street fronts, shall be efficiently protected by non-combustible materials."

There is a misconception on the part of the public as to what constitutes a fireproof building. The opinion is held that buildings such as the Simpson and McKinnon buildings recently destroyed, constructed with iron supports, were intented to be fireproof. This is altogether an error. It was perfectly well understood by the architects of these buildings that the safety of these structures was in no way enhanced, but rather endangered, by the use of an unprotected iron framework. The advantage sought to be gained by the use of this method of construction was rather in the direction of securing larger floor and light areas. As was pointed out in an article on this subject in the *Canadain Architect and Builder* for January, iron should not be used for the support of a building unless covered with fireproof material, such as porous terra-cotta, and it is hoped that the proposed new building ordinance of the city will render this imperative.

A provision which would to a considerable extent enhance the safety of buildings from injury by fire originating on adjoining premises, would be one which would compel the owners of business buildings to protect with iron shutters the windows in the rear walls abutting on adjoining property. Two of the greatest sources of danger are windows and elevator shafts. The windows are broken by the heat, thus setting in motion currents of air by which the flames from burning buildings adjoining are sucked in through the openings, carrying with them destruction to the interior of the building. It is too much to require owners of office and other business buildings to disfigure them by placing iron shutters on the windows of the principal street elevations, but no such objection could be urged as regards the protection of windows on rear walls.

Yet another valuable protection, to our mind, would be movable iron floors in elevator shafts, which should be employed at night to shut off each flat of the building. One of the recommendations of the committee of the O. A. A. is, that such shafts should be lined with fireproof material, and should have fireproof doors at the entrances on each flat; that the shaft should extend three feet above the roof and be covered with glass, which would be easily broken by heat. This provision is a wise one as far as it goes, its object being to confine the fire to the shaft and prevent its spread laterally throughout the building. There is danger, however, that combustible material would be carried through the top of the shaft to the roof of the building and to buildings adjoining. Such a provision as we have mentioned would act as a more complete safeguard, tending to prevent the fire from extending beyond a single flat, where, thus confined, it could effectually be dealt with by the firemen.

Some attention should be given to the construction of floors in a manner that would offer greater resistance to fire. The plastering of ceilings is quite a protection to the under side of the floor, and if floors were lined with asbestos or laid in mortar, a much longer time would be required for them to burn out.

THE MODERN OFFICE BUILDING.

WITHIN the past decade the demands of business have caused such a general change in the class of buildings erected for office purposes, that the architect of the present day is either primarily an engineer or closely allied with those of the engineering profession. The office building of the past was generally a four or five story structure, non-fireproof, poorly lighted and ventilated, and built on the most economical of lines. No particular attention was paid to the comfort of the tenants, well-designed lavatories and elevators were unthought of, and, in fact, the building was simply a series of lofts divided into compartments, poorly finished and badly designed generally.

Twenty years ago a stranger crossing the North River was impressed by the sight of the beautiful spire of Trinity Church, which rose high above the tops of the down-town buildings. As far as the eye could reach there was a level sky line, broken here and there by a few chimneys and steeples. How different the sky line of to-day! Enormous structures, some of which are over two hundred feet in height, with their great weights, would seem almost to crush the narrow section of land on which they stand and bury it beneath the waters of the rivers which flow on either side of the city.

Property in the business sections of New York City has advanced so rapidly in valuation that the rentals of an office building of less than eight or ten stories in height will not pay an interest on the investment. The gradual growth and the recent development of large business enterprises controlled by wealthy corporations, has created a demand for larger and better equipped quarters in which to carry on the business of the corporations. The resultant is the magnificent pile of steel, brick and stone which rises many stories above the sidewalk. The palaces of kings are not more elegantly fitted up and furnished than are the business homes of many of the large corporations. The president has his private office and his reception-room; the directors, their board and dining rooms; the minor officers in turn each his own private office; and the main offices are large, with high ceilings, and most comfortably furnished. The offices are usually trimmed in the most expensive of hard woods, either mahogany or quartered oak, beautifully panelled, moulded, and richly carved; floors are the most handsome of parquetry; railings and hardware of bronze, cast and cut in the most unique of designs; heavily moulded ceilings and cornices are modelled from the best of materials. The offices usually take up the main floors of the building, and the remaining stories, less elegantly finished, as a matter of course, are divided into office floors to suit the convenienee of the tenant; and it is a well-known fact that this class of building rarely has a vacant office. Lavatories, usually on all floors, are large, well lighted, and ventilated. Floors, trim and wainscot are of marble, and the plumbing fixtures are of the most approved make. Elevator service is rapid and regular, the building is heated by steam and lighted with electricity and gas. Each individual main office has a basin with a plentiful supply of water, and towels and ice are furnished to tenants at a very small cost. This is, in general, the type of building that is gradually replacing the old structures. The corporation has set the pace, and the individual owner must needs follow suit or his building will soon be tenantless.

All large modern office buildings resemble one another in general plan and detail, but each in turn must necessarily be an improvement on the one preceding, in order that it may be a paying institution. From the foundation up, every detail must be most carefully studied, and it is the wise man who profits by the mistakes of those who have designed before him. The question of light and air is of primal importance. A building well designed is well lighted by the light of day, and has large wide courts, thin court walls, and sufficient glass surface. It is a mistake to line the court walls with common brick; a pale buff face brick will diffuse the light and more than pay for its use. It is from this court that all interior offices are lighted and ventilated, and practice teaches the architect to sacrifice floor space in planning his building, and lay out, as it were, his floor plan around a court of suitable area.

The subsoil in lower Manhattan Island is a good strong sandy loam, with layers of quick and running sand seldom more than a foot or two in depth. Beneath this the rock is found at varying depths anywhere from sixty to one hundred feet below the surface. Two large buildings were carried down to rock on masonry piers at great expense, one other is carried on wooden pile foundations, and a third method, one in general use in Chicago, that of using a grillage of steel beams and girders, is now about to be employed to carry a building in which the weights will exceed those of any building that has as yet been erected in New York City. The safe bearing capacity of the sub-foundation varies from one and one half tons per square foot to four tons per square foot. Upon the earth bottom, after it has been well levelled off in the case of the last-named building, a layer of one foot in thickness of concrete composed of one part best American Portland cement, two parts clean sharp sand, and four parts small broken stone is put down, carefully rammed and levelled off to receive a layer of steel beams, which are placed one foot apart on centres and well filled between with concrete. This concrete is levelled off one half inch above the top of this layer of beams, in order to receive the next layer, which acts as the footings for piers and columns.

As a general thing the most accepted method of construction is on the "skeleton plan," with columns, and girders carrying thin curtain walls. Steel work is preferred for columns, on account of greater strength and rigidity of connections. Brick is usually of Haverstraw or best North or up-river manufacture, and all exposed walls are laid up in Portland cement mortar. Rosendale cement is most commonly used, but experience shows the architect that on account of the thinness of the walls, the probability of dampness is greatly reduced by the use of Portland cements. All exterior walls are furred with two-inch furring blocks securely nailed up, and on this furring are plastered two coats of rock plaster. Exposed columns, girders, and in fact all structural steel and iron work are usually furred with from two-inch to four-inch hard-burned terra-cotta blocks laid up in cement mortar. There are two methods of flooring in use in this city. The first, and one most generally used, is a flooring of hollow terra-cotta blocks usually ten inches in depth, over which is laid a filling of steam ashes and cement to a height of about three inches above the top of the steel beams, and in this filling are bedded the three-inch by four-inch wooden sleepers to which the top flooring is nailed. A floor of this description was used in the Rhinelander Building in this city. The blocks were twelve inches deep, and plastered on under side with one-inch Portland cement mortar. One of the upper stories was recently entirely burned out. Furniture and fixtures to the value of several thousand dollars on this floor were entirely destroyed, and yet the actual damage to the building itself was less than eight hundred dollars. The wooden floors were charred through to the concrete beneath. The entire story was deluged with water, but the arches above and below were not damaged in the least, and in fact, except for a slight amount of damage from water, the tenant immediately beneath was able to carry on his business without interruption.

The second method, which has recently come into use, is that of stringing wires from beam to beam and filling in a thickness of three or four inches with a mixture of plaster Paris and wood pulp. The ceiling is hung to the beams and filled with the same material so as to leave an air space between the upper and lower layers. Tests of these floors have been very satisfactory. They are absolutely fireproof, exceedingly strong, and fully sixty per cent lighter than a flooring of hollow blocks.

J. Hollis Wells,
Civil Engineer.

(*To be continued.*)

At the request of the Buffalo Chapter of Architects and the Builders' Exchange, the Builders' Exchange Association have decided to open a permanent exhibit of builders' supplies and material. The *Intending Builder* of Rochester has been indorsed as the official organ of the Exchange, and will remove their offices to Buffalo.

Mortars and Concrete Department.

Devoted to Advanced Methods of using Cements and Limes in Building Construction.

AMERICAN CEMENT.

III. — *Continued.*

In 1869 the manufacture of natural rock cement was established at La Salle, Ill., on the line of the same cement rock formation running through Utica, Ill., and has since been in continuous and successful operation.

In 1870 a cement works was established at Howe's Cave, N. Y., and has been operated continuously since then, producing a cement of uniformly good quality, which has been used successfully in many very important public buildings and heavy masonry.

In 1874 the Buffalo Cement Company commenced the manufacture of natural rock cement at Buffalo, N. Y., and owing to the excellent quality of the cement rock, the manufactured product rapidly advanced in public favor.

In 1877 the works were rebuilt on a large scale, and the capacity greatly increased. With almost unequalled facilities for transportation, this company has been very successful, and now enjoys a large and increasing trade.

In 1875 the Milwaukee Cement Company entered upon the manufacture of natural rock cement near Milwaukee, Wis. The success of this company has been phenomenal. With rock of a uniform and reliable character, and with works equal, if not superior, to any in the country, and with splendid transportation facilities, this cement has gained an enviable position in the markets of the West.

In 1883 a large plant for the manufacture of natural rock cement was established at Mankato, Minn. The works are of stone, and present a fine and substantial appearance. The cement rock is of the very best quality, and the manufactured product has obtained a strong foothold in the markets of the Northwest. Mortar made from this cement becomes exceedingly hard and stone-like in character, whether above or below water, and withstands to a remarkable degree the disintegrating effects of alternate freezing and thawing.

In closing this brief and incomplete *résumé* of the rock cement industry in this and foreign lands, it may be well to emphasize the fact that in no other country of the world is there to be found cement rock formations which are at all to be compared with those so well distributed throughout the United States.

The principal source of rock cements in England is from the Liassic or upper and lower Blue Lias subdivision of the Jurassic rock formation, extending from Lyme Regis on the south coast in a northerly direction to Yorkshire on the north, and averaging some thirty miles in width.

From the Memoirs of the geological survey of the Jurassic rocks of Britain, and more especially the report on the Lias of England and Wales, by Horace B. Woodward, London, 1893, we glean certain facts regarding bed formations and the source of the Roman or rock cement supply in that country since the days of Parker to the present time, from which we can readily understand why the artificial production of cement was resorted to.

The Lower Lias, from which the rock cements are obtained, consists in its lower portion of layers of blue and gray limestones, more or less argillaceous. These layers occur sometimes in even and sometimes in irregular bands, often nodular and interrupted, and they alternate with blue and brown marls, clays, and shales. Nowhere in the Lower Lias is there any marked band of rock which can be traced continuously for any great distance. The higher portion of the Lower Lias consists of blue, more or less micaceous clays, shales, and marls, with occasional septaria nodules and bands of earthy and shelly limestones and sandy layers. There is no rigid plane of demarcation between them and the mass of limestones beneath, while the clays pass upward into the lower beds of the Middle Lias with no lithological break or divisional line.

There is no layer of the rock used for cement purposes which does not vary in its proportion of clay, ofttimes as much as twenty per cent in individual quarries; and we find that whereas one layer may contain eight per cent, the one next above or below may contain fifty per cent of clay.

Clearly it is not remarkable that a cement made from such an ill-assorted mass of material should lack uniformity. No rational man in America would dream of undertaking to produce a rock cement from such a jumble of clays, shales, marls, nodules, limestones, and cement stones. Is it then to be wondered at that artificial mixtures were employed in an endeavor to meet and overcome the dissatisfaction unavoidably growing out of the use of such natural rock cements?

Contrast these materials with our own massive cement rock deposits! Here we have immense beds of cement rock absolutely free from any extraneous substances, perfectly pure and clean, with layer upon layer, extending for thousands of feet, without the appreciable variation in the proportion of ingredients.

Cement rock quarries are worked in this country decade after decade without the necessity of discarding a pound of the material, and analyses taken during successive years show no changes whatever in the constituent parts. Had England possessed such cement rock formations as are distributed throughout this country, it is extremely doubtful if the production of artificial cement would have been resorted to. Under such circumstances there would have been no occasion for it.

The magnitude and value of the work done with the rock cements of this country is almost beyond comprehension. They have been used in the largest buildings, tunnels, bridges, dams, and aqueducts constructed in America, and a failure has yet to be reported and recorded. More than seventy-seven million barrels have been so used during the past twelve years.

In subsequent chapters the various rock cement deposits of this country will be discussed in detail, with descriptions of the various plants, together with a mention of the important works executed with the various brands, the magnitude and permanence of which should set at rest all question and all doubts concerning the enduring qualities of American rock cements.

URIAH CUMMINGS.

(*To be continued.*)

LOS ANGELES, CAL., March 15, 1895.

EDITOR OF THE BRICKBUILDER.

Dear Sir, — I have read in your valuable publication with great pleasure several very interesting articles on Portland cement, and am not only thoroughly familiar with the manufacture of this valuable building material in America, Germany, England, and France, but likewise as cement contractor and specialist am daily using large quantities, and by continued practical use and theoretical knowledge obtained by years of study combined have become intimately acquainted with the qualities of the different products and brands. With the following for the benefit of the new industry in this country, where Portland cement is coming daily in more extensive use and where so little of a proper quality is as yet manufactured, I will preface the article with

WHAT IS PORTLAND CEMENT?

Portland cement is a product obtained by burning a close mixture of materials containing lime and clay to a high degree of heat 3000° to 3500° Fahr., then grinding to flour fineness. Since the product so obtained in color as well as in crushing strength resembled the Portland stone, Joseph Aspdin of England, the discoverer of the cement in the year 1824, gave it the name of Portland cement; notwithstanding that Portland cement cannot be produced from the Portland stone.

Portland cement can be manufactured anywhere where limestone and clay containing the requisite ingredients can be obtained at a reasonable price, but very seldom do we find cement rock deposits containing lime and clay in the right proportion required for Portland cement. The product of the various factories differs so very materially that it becomes absolutely necessary in the erection of larger buildings and complicated cement constructions to test the tensile and crushing strength of the cements to be used therein, and to continue these tests at intervals, even if the same brand is used on the same work. I always prefer that cement which exhibits the greatest tensile strength, and above all the greatest uniformity and fineness; but these qualities are the great desideratum with our American cements, which I have used extensively, and invariably found the lack of continued uniformity and tensile strength. For a time they will be equal to the best imported, and all at once the same factory will bring an article into the market with hardly any tensile strength, far below the average, or which sets too fast or not at all; and on this point I must coincide with the remarks of Mr. R. F. Tucker, when he says, "The Portland cements of American manufacture have a long road to travel before reaching the standard of excellence achieved by our rivals across the water."

I have found during many years of practice that the most uniform cement is the German, and especially the celebrated Dyckerhoff, also the Heidelberg, Alsen, Germania, and the Mannheimer brands.

Mr. Hartranft combats the article of Mr. Tucker and mentions (with justice I admit) the extensive plant of the Copley Manufacturing Company, which I consider the largest Portland cement factory in the United States, but which stands no comparison with the German factories above mentioned.

If Mr. Hartranft would visit these factories he would find, first, the most perfect and complete chemical laboratories, the most economic use of fuels, utilization of space, and above all the conscientious management of the entire factory, based upon scientific investigations and theoretical and practical knowledge, and would also find in these factories a perfect absence of the annoying and dangerous cement dust.

The raw material used in the Copley factory is a superior article, as good as can be found anywhere. The deposit is in close proximity to the plant. Its chemical ingredients are such that by direct burning from the deposit it will produce a good hydraulic cement.

The Portland cement from this factory is as good as any manufactured in America.

The lately erected factories in Germany are all handsomely designed brick structures, and as to the arrangement of light, ventilation, and proper working facilities the greatest care has been exercised in their construction. The kilns are continuous; and the thorough burnt klinkers after cooling are carefully separated from those that are not perfectly burnt; the latter are burnt over again, a process which is not so closely adhered to in the manufacture of our American cements, but which is one of the points so essential to the production of a uniform cement.

Another good point in favor of the German cement manufacturers, which greatly assists the cement industry in that country, is the existence of a German Cement Manufacturers Association (Cement Verein), which a great many cement manufacturers from other countries have joined. The most prominent cement engineers and chemists are active members of it. The association convenes twice a year, to fully discuss the cement industry and adopt such measures as are required by the exigencies of the times to mutually protect it.

New inventions or improvements in machinery, kilns, etc., are laid before the meetings, and all questions of interest discussed, and much knowledge is thus disseminated; but above all do they pay particular attention from a scientific and practical point to the norms of cement for the benefit of the industry at large.

These meetings and discussions have, no doubt, in a great measuse tended to give to the German cement manufacturers the very best and most improved methods of manufacture, and placed them in the front rank, leading all other countries in the production of quantity as well as quality. Their example has induced manufacturers in other countries to proceed in like manner, and to adopt some, though with slight change, the norms of the German manufacturers. Since the established norms form the rules for the factory, they act as a spur to correctness for themselves, and force to further perfection of the manufactured article, which will not only be beneficial to the public at large, but it will tend to elevate our industry, and bring our cements in time to that standard of excellence which will make us independent of foreign importation.

I regret to state that even our most prominent engineers seldom test the cement they are using in the right manner, but test it in its pure state, which is a mistake, as cement is never used in its pure state, but is invariably mixed with sand, and that cement which with a certain tensile strength takes up the most sand is certainly the best and cheapest.

It is surprising, yet true, that the good coarse-ground Portland cement, in its pure state, will show greater tensile strength than the same article finely ground.

I think that the time has arrived when our Portland cement manufacturers should induce the government to establish national testing offices, where all brands that come into the market will be scientifically and impartially tested, and where, with the assistance of the cement manufacturers, a uniform testing method will be adopted and adhered to, and standard norms established.

The manufacturer would then strive to work his product up to these norms and to uniformity, and it would be to his interest to see that no cement leaves his factory which does not come up to the norms adopted, and is of uniform quality.

C. Leonardt.

VARIOUS SYSTEMS OF CONCRETE CONSTRUCTION.

(*Continued from March number.*)

CONCRETE AND TWISTED STEEL.

THE use of the twisted steel bar to impart tensile strength to concrete is one of the most important discoveries ever made in this branch of construction. The use of the plain rod is obviously objectionable, for the reason that the hold of the cement on the iron is merely one of adhesion, and the limit of strength imparted to the concrete is the amount of adhesion of the two materials. This is a small quantity, but it is obviously increased by putting large washers and nuts on the ends of the rods. Naturally this is expensive and bothersome, and the loads are transferred largely to the ends of the rods, instead of being distributed uniformly along the bar. The use of the twisted rod therefore is apparent. A bar of square iron or steel is twisted cold. This forms a series of spiral grooves about the bar along its whole length. The iron being carefully imbedded, the concrete finds its way into the grooves and holds the bar at every point, so that it is necessary for it to shear the concrete at every point from one end of the bar to the other, in order to separate the cement from the steel. This is impossible within the working strength of the two materials. The bar is easily and quickly twisted, and the whole strength of the iron is imparted immediately to the concrete. The use of smooth and the twisted bar is analogous to the use of the nail and the screw in woodwork.

The basis then of this system of construction, which was invented by Ernest L. Ransome of San Francisco, “is the method of introducing iron with concrete in such a manner as to give to the concrete beam or girder the power to resist tensile stresses as if the beam were of a fibrous or homogeneous material, like iron or wood. In such a construction it is essential, first, that the iron and the concrete be so united as to enable each to act immediately with the other in resisting stresses; second, that the bond between the two should be continuous and equal from one end of the beam to the other; third, that the elastic limit of elongations of the two should be made as nearly equal as possible. These requisites are all practically simply and quickly met by imbedding in the tensile area of the concrete beam a square bar of cold twisted iron.”

“This system of concrete and twisted iron construction is, by reason of its great strength, durability, its lightness, its fire-resisting qualities, and withal the economy in its use, of almost universal application in concrete, and is designed to cover the entire field of iron, stone, brick, and terra-cotta construction, including the laying of heavy foundations and piers, the construction of monolithic buildings for all purposes, of concrete beams and girders for all spans and loads, and of monolithic fireproof floors in place of heavier and more expensive methods.”

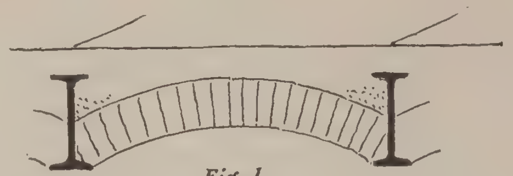


Fig. 1.

One of the first methods of using concrete in floor construction was merely as a filling over brick arches (Fig. 1), and this system, uneconomical and obsolete as it is, is still in use.

The next step was to do away with the brick arch and use the concrete for distributing the load on to the bearers (Fig. 2). A finished surface being made, this formed a very good floor, the only defect arising from the cracking of the floor along the bearer, in cases of overloading. This is especially objectionable in malt-house floors and in other places where there is much dampness and danger from germs and other growths. The cracking of these floors is largely obviated by a device shown below, in which the concrete over the beams is cored out between two joints, and after the main body has set, the core is filled in and finished (Fig. 3). The deflection of the beam may thus be taken up without danger of cracking the surface. This has been used largely by Mr. Ransome in various important works.

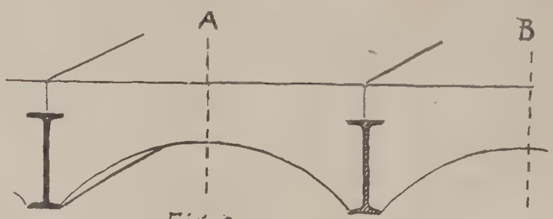


Fig. 2.

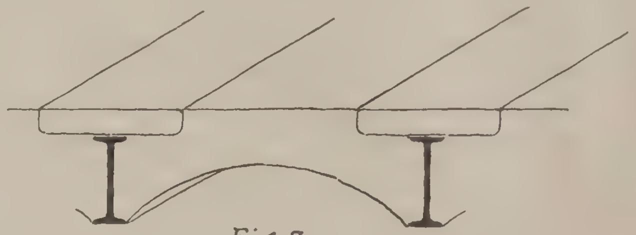


Fig. 3.

The concrete for such arches should be composed of one part high-grade Portland cement, two parts sand, six parts broken stone, all thoroughly mixed and wet to the consistency of a stiff dough. The top should be composed of one part cement to two parts coarse sand, put on immediately after the bottom is in and trowelled down to a hard surface and carefully jointed.

It will be seen from a study of Fig. 2 that considering the portion between A B to act as a beam independently of adjoining sections, that there is obviously a waste of both iron and concrete for the strength required; that the section of concrete is not in proportion to the section of steel; that a portion of the section of steel is in the compressive area of the beam, and that the remaining section is not suitably placed for imparting its strength to the concrete. In other words, we may do away entirely with the upper section of the steel beam, and simply taking the amount of material in the lower section, convert it into bars, and imbed it in the concrete in the manner shown in Fig. 4.

This then is the first step in doing away with the steel beam, the section of the concrete remaining practically as in Fig. 2.

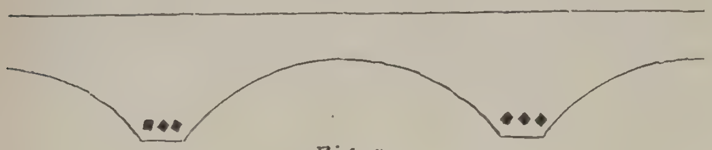


Fig. 4.

This section of floor was used some seven or eight years ago in Bowen's wine cellar in St. Helena, California (Fig. 5). The architect,[1] in a recent paper, says: "This building is four hundred feet long, seventy-five feet wide, and three stories high. The entire site is cut into the side of a gently sloping hill along the entire length of the rear, and at the levels of both first and second floors, while beyond the driveways and retaining walls are thirteen tunnels, sixteen feet wide, penetrating the hill about two hundred feet. On the site of the building, and immediately surrounding it, were an abundance of bowlders, of very hard basaltic stone, quite unsuitable for rubble stonework, owing to their rounding form, but excellent material for concrete when crushed; the finer materials were obtained in the form of gravel from a neighboring creek. A good quarry of the soft but durable volcanic tufa, so common in Napa Valley, was found within half a mile of the building, and as it could be quarried, hauled, and built into the walls for seventeen cents per cubic foot, it was employed for all walls and partitions of the building. The foundations, retaining walls, lining of tunnel entrances, and main floor laid on the ground were formed of concrete in the usual manner. The entire second floor, together with the driveway at the level, was constructed with concrete and twisted iron rods in the form of beams and elliptical arches, as shown in Fig. 5, and as here described. Two rows of iron columns seven feet four inches on the centre were placed lengthwise of the building, dividing the width into three sections of about twenty-five feet each. The floor was constructed with concrete beams seven feet four inches on centres passing entirely across the building, with their soffits resting on the iron columns. The beams were twenty-four inches deep from soffit to surface of floor, and each had four 1¼″ x 1¼″ twisted iron rods near the bottom, with a vertical joint along the centre of each beam, protected against leaking by a strip of lead imbedded in each half of the beam. The arches between the beams were elliptical in form, and the concrete five inches thick at crown of arches.

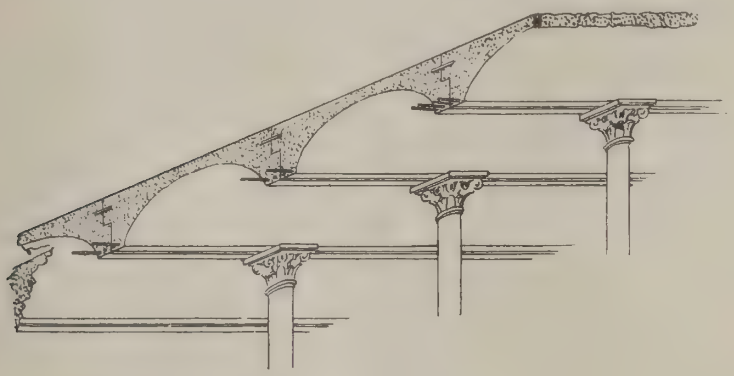


Fig. 5.

"This floor was estimated and intended to carry with safety on each beam, for each twenty-five foot section, two casks, each containing two thousand gallons of wine, or a total weight, including cooperage, of forty thousand pounds, on each section 7′ 4″ x 25′, or about two hundred and twenty pounds per square foot, uniformly distributed. The arrangement of the casks was intended to leave a gangway eight feet wide in the centre of each section, thus giving less stress than a uniformly distributed load.

"Before the building was finished one of these sections was tested with a uniformly distributed load of three hundred pounds to a square foot, and produced a deflection of one eighth of an inch at the centre; on removing the load the beam returned to very nearly its original position. Since the building has been occupied many of the gangways have had tiers of large casks placed two in height along the entire length, and smaller casks set between the upper bilges of the large casks, thus loading the floor largely in excess of its intended capacity. Implicit faith seems to be placed in this construction, by those engaged about it, that it will carry anything that can be put on it. These floors have now been in use four or five years, and answer the purpose for which they were designed by making a strong and non-absorbing floor, and assisting in keeping a uniform temperature throughout the building."

These facts illustrate perfectly the value of the principle involved, that of allowing concrete to do its work in compression, while the steel does its work in tension. A still further study of the section shows that economy and strength are to be gained by cutting out a part of the concrete in the haunch of the arch, by deepening the beam, using a single bar, and bringing the beams a little nearer to one another, as in Fig. 6.

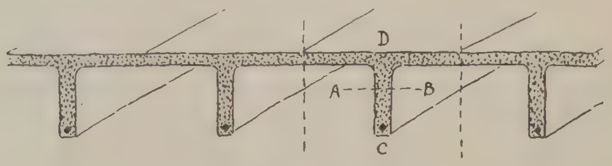


Fig. 6.

This section presents a typical form of Ransome floor, and one which has been used continuously in a number of cities for many years. It is extremely light, strong, water and fire proof, and especially adapted to breweries, packing houses, and other buildings of that nature.

The theory upon which these beams are constructed may be briefly described as follows. It is well known that the ratio of the strengths of concrete and iron is about one to forty; in other words that concrete in compression has about one fortieth the strength of iron in tension, using twenty tons per square foot as the safe strength of concrete, and about ten thousand pounds to the square inch as the safe strength of iron. Therefore in designing a concrete beam we assume a T section (Fig. 6), supposing the neutral axis to be about at A B. Supposing the beam to be supported and loaded in the ordinary way, the section below A B is in tension, the stress increasing as the distance from A B increases, being greatest at the bottom C. Similarly the section above A B is in compression, the stress being greatest at the top D.

Therefore the greater part of the concrete should be assembled as near as possible to the top D, say within the upper third of the distance from A B, in order to be most effective in resisting compression.

In designing such a beam, it is first necessary to determine the amount of fibre stress developed at C, due to a given load, the beam being of a given span. The depth of the beam is assumed for the moment. A bar of iron of a section sufficient to withstand the strain thus determined is imbedded as low as possible within the tensile area. Then we make the area of concrete within the upper third at least forty times the section of iron used in the bottom. We now have a section which for the given span and load is sufficient both for resisting tension and for resisting compression. The materials used are doing their own work, in a way best suited for them to do it. In a subsequent paper more will be said upon the adaptation of this principle in floors and girder work, and some illustrations of work already done will be given.

Ross F. Tucker.

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[1] G. W. Percy, Proceedings of S. F. Chapter, A. I. A.

The Mason Contractors' Department.

Conducted in the Interests of the Builder and the Contractor for Brickwork.

"SIDE TALKS WITH THE BUILDERS."

AFTER one of the most severe winters in the history of our country, springtime is at hand, and with it comes the customary rumors of gigantic building projects, of which fully one half generally prove mere fizzles, products of the imagination of some aspiring reporter.

Many contractors, and especially the younger ones, are apt to be far too eager to secure work at the opening of the season, taking contracts at little or no profit, just for the sake of getting the work, oftentimes loading themselves up with these contracts for the entire season at poor prices, with small profit; while the older and more experienced builder, if not able to secure a fair price, will content himself with jobbing till midsummer, when his near-sighted and more eager brethren, loaded with all the work they can manage, are unable to figure on more work, and thus enable the shrewd man to take contracts with profit.

Far less would be the number of failures among mason builders, and in fact among contractors in general, if they would profit by the experience which others have paid dearly for; in other words, "be more cautious and less ambitious." No doubt ambition is a virtue in some cases, but in the case of young mason contractors especially it generally proves fatal. Better by far go into the fields and gather Mayflowers or listen to the song of the bluebirds, than be doing work that you know will not profit you enough to buy a suit of cast-off clothing, and will certainly gain you no reputation.

The public as a rule puts more confidence in the man who figures to make a dollar, believing that he can afford to do good work; while the man who takes work with no chance of profit is very likely to slight the job in order to get out whole.

The proportion of chimney flues is a question that most masons are not well acquainted with. The old rule concerning chimneys was to the effect that the flue should be tapered to the top, on the theory that as the hot gases pass upward they become cooled, and in the process of cooling they become contracted; also that it was important to reduce the size of the flue in proportion to the reduction in volume of the gases, as otherwise cold air from the top would descend and fill the vacancy caused by the contraction of the gases, and in this way the draft would be checked. Reasonable as this theory seems, practice has shown that cylindrical boiler or furnace flues are at least as good as the tapered ones, and within a few years engineers and architects of experience in such matters have shown a disposition to make them slightly larger at the top than at the bottom, the increase of diameter being, perhaps, one half inch to ten or twelve feet.

Not long since a Swiss engineer made experiments to see whether the facts bear out the old rule or support the modern practice. To make the test he built a chimney over a furnace grate, the stack having two flues. One flue tapered upward and the other downward, and the flues opened side by side over the grate, with openings of the same size.

On lighting a fire on the grate with unlimited access of air under it, the smoke was seen to issue nearly equally from the top of both the flues, but with an unmistakable preponderance in favor of the flue which enlarged toward the top. On partially shutting off the access of air to the flue, the difference became much more marked; the current in the flue tapering upward diminished, and finally stopped altogether, the smoke finding its way entirely through the flue with the *wider top*.

The importance of selecting proper brick for constructing buildings is so evident that it needs but the statement of the fact, without argument, to have it generally accepted.

It is plain that in the construction of buildings care ought to be taken to have them of such architectural design as to present an agreeable impression to the eye; but as they are intended for the future as well as for the present, they should be of such materials as to withstand the ravages of time.

Even a limited examination of edifices, public and private, discloses the fact that brick of the same general character vary greatly in serving the same purpose. While some preserve their soundness after years of exposure, others quickly show signs of decay and rapidly crumble, requiring continuous repairs to keep them in proper condition. In some buildings cracks and fissures appear in them, the material not being in all cases of sufficient strength to resist the pressure. In other buildings a similar variety of brick, though subject to equal or greater pressure, remains unimpared. The value of building brick, therefore, may be briefly expessed as depending upon two causes: first, physical constitution; second, their chemical composition.

The most important in its results of all experiments regarding brick is the determination of the force required to crush them, and the importance of determining the resistance of building material to pressure cannot well be overestimated. It gives accurate information obtainable in no other way.

The crushing strength of bricks of course varies greatly. A rather soft one will crush under from 450 to 600 pounds per square inch, while a first-rate machine-pressed brick will require about 6,222 pounds per square inch. This last is about the crushing limits of the best sandstones, two thirds as much as limestones and marbles, and about one half as much as granite or roofing slate. But masses of brickwork crush under much smaller loads than single bricks. It must be remembered, however, that cracking and splitting usually commence under about one half their crushing loads. To be safe the load should not exceed one eighth to one tenth the crushing limit.

The approach of May 1 reminds me that this day of all others is generally the one selected for the inauguration of great labor strikes. This year, however, the indications are, among building trades at least, that the day will pass without any serious rupture.

The logical conclusion from the present position of building trades must be that the members of unions recognize the value of intelligent rather than hot-headed leadership. Master masons, as a rule, are seldom disposed to discourage unions, but frequently have occasion to criticise the senseless and unfortunate methods adopted. One trouble with trade unionism as practised, as far as known the world over, is that it attempts to create a close monopolistic corporation. It is the same principle at the other end of the line that actuates the great corporations known as "trusts," which every "reform" politician is just now crying down. It is the same feeling which on the part of the union cuts down the number of apprentices, and interferes with boys learning trades, that actuates the trusts that attempt to control all the salt works, or all the sugar refineries, or any other great commodity, and both ultimately, when acting on these principles, end in disaster.

Builders have had frequent occasions to lament the lack of good mechanics and skilled artisans. To a certain extent every union could be a school of its trade, and thus render a substantial benefit, not alone to its members, but to the community at large, by raising the standard of workmanship, and thus make employers pride themselves on employing union men. Unions, too, could adopt some system of gradation, according to the ability, and not grade all with the poorest as at present.

Trade unionism will reach its greatest success when it learns to become an organization of progress, and bases its claims for employment on the mechanical ability of its members. I do not say that conflicts arising from greed on either side will be entirely avoided; but as the value of union men as against others comes to be appreciated, there will be greater efforts made to adjust differences, and under intelligent leadership the value of labor and the equitable wages, in accordance with the state of business, will be better known and concessions on either side more readily made.

If the unions can so train their men in skill and faithfulness that the production of the average union workman is one third more than the non-union, the world will quickly appreciate it and pay him accordingly. The walking delegate should feel it incumbent upon him to see that a fair day's work is given for a fair day's pay. Under such circumstances the employer would become the steadfast friend and supporter of the trade union, and May 1 would be only a reminder.

R. N. BUELL.

VANCOUVER, B. C., March 14, 1895.

EDITOR THE BRICKBUILDER.

Dear Sir, — I wish to say that I am much pleased with the changes and additions which I find in THE BRICKBUILDER. Placing an index of contents on front cover and dividing them under the different headings is an improvement which every busy man must appreciate. I would like to see a larger proportion of your space devoted to my particular department, that of the mason contractor. I think I may say this without appearing selfish, though I know nothing about the proportion of mason contractors on your subscription list. In your January number less than two pages of the twenty-four are devoted to the brickbuilder proper; the others are of more practical use to the men who design our buildings and specify what we shall use in them. The whole journal, including advertisements, is of general interest to contractors, but we would like to see more in our own particular corner.

I will take the liberty to give you some incidents in our experience as mason contractors, and ask you at some future time to enlarge upon them and answer some questions concerning them. The first is suggested by your article on foundations and building beside old buildings which have poor foundations.

We would like to know something about the by-laws of different city corporations with reference to the foundations of buildings. Here they regulate the thickness of the walls, but not the depth, and in several instances buildings have been put up with shallow or shoddy foundation walls built to the line of an adjoining owner, and thus depreciating the value of his lot for a building with a basement. We recently completed a brick and stone block with one side wall 120 feet long resting on a very shallow foundation, which has a stone footing course about twelve inches thick projecting six inches on the adjoining lot. This was designed by an architect who is a F. R. I. B. A. Without the footing the wall would hardly be safe. We would not care to put in a basement next to this building. We had one contract of this kind, a brick store with stone basement next to a brick block with a shallow foundation badly built. The owner of the new building, who estimated the risk as but trifling, kept the excavating in his own hands, which was very fortunate for us. The soil was wet and treacherous. Before he had removed much of it, the old building commenced to crack, and in a few minutes the whole side fell out. It was fortunate that the floors were not heavily loaded, for then the whole block would have been wrecked. The owner of the new building had to rebuild the wall and pay damages. The wall which fell was apparently a good wall above ground; a photograph would have shown no defects.

In your article on scaffolding you mention the fact that contractors too seldom consider the safety of either themselves or their employees. The Employers' Liability Act of this province is such that every contractor who is at all prudent is obliged to consider this question of safety.

We have tried several systems of accident insurance for employees. We now have a policy which seems very fair. The premium (annual) is based upon the amount of wages paid annually. We pay one and one fourth per cent, which gives our men one half their wages for a term not exceeding twenty-six weeks if they are totally disabled by an accident either in or out of working hours. In case of the accident causing death, their heirs get full wages for twenty-six weeks.

This is the best protection in the way of insurance in Canada, and *it* is not what we should have; a contractor is not safe unless he has his sub-contractor's men covered. Here a difficulty arises in determining the amount of wages paid out by the sub-contractors. Evidently there is room for something better in the way of accident insurance. Our policy does not cover accidents to the outside public. The city by-laws usually require builders to protect the public. This would not be a hard matter, if the public would keep sober. Unfortunately, however, there are in every city men who are apparently on the lookout for trouble. It is this worthless, drunken class who are most apt to trouble a builder, — men who have nothing to lose and who have, or think they have, a chance to make a contractor share up his profits, which are small enough in these days of keen competition.

It is impossible for a contractor to keep the street entirely clear of obstructions. When he least expects it some one stumbles over a stone or piece of board, receives a slight injury, and at once puts in a claim for heavy damages, which claim is usually reduced to an amount which it is well known is less than the expense to the contractor of a lawsuit, even should he win it. Such claimants seldom have means to pay court costs in case they lose the suit. If the contractor is wise enough to look at such a case from a financial standpoint only, he will settle at once rather than risk a suit. We can buy a policy which will protect us from such claims, but the best are not satisfactory. I'm sure that some information on this question of employers' liability laws and insurance will be very welcome and of much practical value to both brick builders and brick makers.

Yours respectfully,

A BRITISH COLUMBIA BRICKBUILDER.

EDITOR OF THE BRICKBUILDER.

Dear Sir, — I am glad to note the interest expressed by Mr. A. H. Cope in my first article on "The Use of Brick in Domestic Architecture," and hasten to explain the points which he wished elucidated.

The little cottages shown as suggestions in my article have never been built, and are simply suggestions, not only in point of design, but in the matter of proposed construction for the economical use of this eminently durable and desirable material.

Mr. Cope asks whether the walls are to be bonded with metal ties or brick headers. In reply to this I would say that the method proposed was the tying of the two 4″ walls by means of some metal tie, an excellent form being the "Moss Wire Wall Tie," which is made either of copper or galvanized iron, galvanized iron being in the present instance recommended on the score of economy. The walls would, I think, be sufficiently stable under these circumstances, provided they did not exceed eighteen or nineteen feet in height. This would allow for a two-story building. In the event of any large girders being used, it might be well to re-enforce the walls at their bearings by an increase of the inside wall to 8″.

Mr. Cope is probably both right and wrong in the matter of dampness in the walls. While undoubtedly the greater part of the moisture that would show itself on the inside of a solid brick wall would be due to the difference in temperature of the wall and the air in the room, still, under severe conditions, experience has shown that outside moisture will force its way through a solid brick wall of considerable thickness, while it undoubtedly rises several feet from the ground unless some kind of damp course is provided. In a hollow wall, such as is recommended in the case of small brick dwellings, there would be no opportunity of this driving through of the moisture, while the air space would of course serve to equalize the temperature in the wall, and so prevent the condensing of moisture on the inside surface.

Very truly yours,

RALPH ADAMS CRAM.

THE MANUFACTURER.

CORRESPONDENTS' LETTERS.

PHILADELPHIA opens this spring with not a little activity in the building circles. Contractors are looking for a boom, which they feel assured will materialize in the near future. The bulk of the operations commenced thus far are residences, and some of them are quite extensive, but there are well-founded rumors of large office buildings, hotels, places of amusement, and public buildings.

Yet all this pleasing prospect may be sadly marred within the next few days, if the associations of masters and journeymen bricklayers will be unable to agree upon a scale of wages for the current year. The difficulty seems to be a question of wages: the journeymen claiming forty-five cents an hour, and the masters asserting that forty cents will be sufficient for the current year. It appears that the journeymen received forty-five cents last year by reason of some misunderstanding, and that rather than have a strike at that time the masters acquiesced; but they now desire to restore the former rate of forty cents, and thereby regain the position they claim to have lost through some technicality or misunderstanding. It is to be hoped that proper discretion will be used upon both sides, and a strike, which would mean a stagnation in all the building transactions now in progress and prospect, and blight of a seemingly busy and prosperous year will be avoided.

Architects are busy pondering over the programme for a competition for designs for an Art Museum, which is to be built in Fairmount Park; and those who are seriously thinking of entering are endeavoring to find out, if possible, where they shall commence, or what they shall make in the matter of drawings. The programme is most peculiar in that it does not say what drawings shall be made, at what scale they shall be, how they shall be rendered, nor is the probable location of the building given, a plot of the grounds being referred to, which, I understand, is not now in shape to be given to intending competitors. It would seem that the programme should have a thorough revision by some one who understands the conduct of competitions of this kind; but here seemingly is the place where the error has been made. It appears as though the commissioners do not want it to go forth as a full-fledged architectural competition, but rather as a competition for designs and ideas, which shall afterward be compiled and used by an appointed or selected architect, and made use of in the final plans for the work; or they may wish this to be a preliminary, leading up to a final competition. Whatever is their wish does not appear plainly upon the surface of the declaration, and every one is at sea, and the prospect of a miserable failure is imminent. The prizes are quite liberal for preliminary work, if that is what is wanted, but the statement speaks vaguely about specifications, proposals, etc., and no one knows what to submit; indeed it would seem that in order for any one to satisfy himself that he is fulfilling the requirements of the programme he would be required to furnish full drawings, specifications, details, and a proposal for the erection of the work.

As the building is of so much importance, and is to rival any of a similar kind in the world, it is to be hoped that some definite and satisfactory revision of the programme will be made, and made in such a manner that the best talent in the world will be brought into the competition. If such is not done the prospects are that it will end similar to some other recent Philadelphia and New York competitions.

BROOKLYN. During the last few months there have been numerous large building schemes projected in the City of Churches, among which is the new Montauk Theatre, Messrs. McElfatrick & Son, architects, which will be built according to the most *fin-de-siècle* methods of construction. It has an excellent three-story stone façade on Fulton Street, running back one hundred and twenty-five feet to DeKalb Avenue, with eighty-eight feet frontage on the latter. It is being built by a stock company, and will be used as a theatre, with bowling alleys and billiard parlors in the Fulton Street wing.

Over in the vicinity of the Wallabout Market can be seen the chaos and *débris* occasioned by the demolishing of the old market buildings to give place to the new market houses (Mr. W. B. Tubby, architect), which will consist of nine elegant structures, each occupying a block of one hundred feet by two hundred feet, having a frontage of one thousand feet on Washington Avenue. These buildings, which are to be built under the supervision of the Department of City Works, will cost between thirty-five and forty thousand dollars each, and will be built as nearly fireproof as possible.

The city is doing no little part of the local building, as it is about to enlarge the Hall of Records, and has recently appropriated the sum of forty-five thousand dollars for the improving and placing of an elevator in the City Hall, besides having several large school buildings under way, averaging one hundred thousand dollars each.

CHICAGO. Jack Frost played an expensive joke on at least two new Chicago buildings. One of these is the Tegnard, a six-story office building on the river just at the head (or foot) of Wabash Avenue. The construction is "slow burning," according to the definition in the Chicago building ordinances, and the five stories of piers on the two street fronts are carried on I beams over the store fronts. These piers are sixteen inches thick in second story. The second-story brickwork was laid in cold weather when the mercury stood at about 10° Fah. below zero.

Salamanders were sparingly used while laying the bricks in hot lime mortar, but the common brick for backing, second hand, water soaked, and frozen solid, were laid without first being heated. As a natural result when the frost came out (which occurred about the time this building was ready for roof), the piers came out, too, or rather, the bottoms of the piers were thrown off the supporting beams from one inch to four inches, making a very noticeable batter in the second story. Six of these, the worst of the piers, five to six feet wide, were shored up at third-floor level and the second story was torn out and rebuilt. The terra-cotta band course, covering beams at second-floor level, were badly displaced and a few pieces crushed. The terra-cotta lintels over windows were crushed in several cases. These were coverings for small I beams. When the frost came out the joints of the brickwork compressed enough to crush the terra-cotta lintel coverings and bend down the heads of window frames. It was noticeable that the piers damaged by frost were five and six feet wide, while the narrow piers, three feet wide, which were built with more care and *not* with joints, seven eighths inch thick, were but little affected. It would seem to be a point worth while calling to the attention of architects that in cold weather brick should be laid with close joints, and that the brick should be so dry that they will absorb moisture from the mortar and enable the latter to "freeze dry." This is mentioned because the writer has seen walls in which the mortar had not set two months after laying, and because the second building referred to above had to have two or three stories taken down to foundation and rebuilt.

In justice to the architect of the Tegnard Building, it should be stated that he warned the owner and contractor against the use of the old brick, but was not allowed to dictate in the matter.

ROCHESTER. The building outlook for Rochester this season is exceedingly dull. Very little new work has come into the offices lately, though much of last season's work is now being finished.

Considering the hard times, last year was an unusually busy one for the brick-building business. The Chamber of Commerce Building is the largest of the buildings now being finished. It is thirteen stories high, fireproof, steel construction, and is built of the Eastern Hydraulic Pressed Brick Company's buff brick, with white terra-cotta trimmings, furnished by New York Architectural Terra-Cotta Company.

It is intended for general office purposes, with stores on first stories, and is architecturally divided into three stages, — the first three, the next eight, and the two upper floors which are to be used for Chamber of Commerce purposes. It is surmounted by an ornate and heavily bracketed cornice. The first three stories are in brick and terra-cotta used alternately in stripes. The second stage is quite plain, but very good; it is divided into panels with pilasters between, and the stories are separated by panels of moulded terra-cotta. The Chamber stage is entirely of terra-cotta, boldly modelled. The porous terra-cotta floor, etc., are furnished by Staten Island Terra-Cotta Lumber Company. Architects, Nolan, Nolan & Stern.

The new Central Police Station and Woodworth Buildings are two other fireproof structures which are almost complete. The former is four stories cut stone and New York hydraulic pressed brick. Architect, Herbert W. Pierce.

The latter is six stories with basement and sub-basement. It covers about the same area, and has pressed brick and terra-cotta front. It is erected to be a first-class manufacturing building, and is one of the best examples of this kind of building in the city. Architects, Ellis Bros. Both of these buildings are iron construction.

The Stillson Street, No. 2, Fire Engine House is another good example of brick and terra-cotta work done here lately. It is in style Flemish Renaissance, and is three stories high, and has a richly moulded terra-cotta entrance, and the dormers and window arrangement make it the most attractive building of its kind in the city. Architects, Nolan, Nolan & Stern.

Work now on in the offices for which the contracts have been or are about to be let are, block for C. B. Woodworth, State Street, six stories, 100 x 135 feet, fireproof. Building for Mr. H. H. Craig, Paul Street, seven stories, 132 x 155 feet, and annex 40 x 60 feet, fireproof, brick and terra-cotta. Architects, Ellis Bros. Building for B. H. Clark, West Street, 50 x 100 feet, four stories, slow burning. Architect, C. F. Crandall.

HARTFORD, so long known as the home of the insurance companies, is about to have an addition to its list of buildings devoted to this business.

The Travelers Insurance Company have, for some time past, contemplated the erection of a larger and more modern building than the one they at present occupy; and I understand that Mr. Ernest Flagg, of New York, has been commissioned to prepare the drawings for a building which will provide a number of stores and offices, and also better accommodations for their own offices.

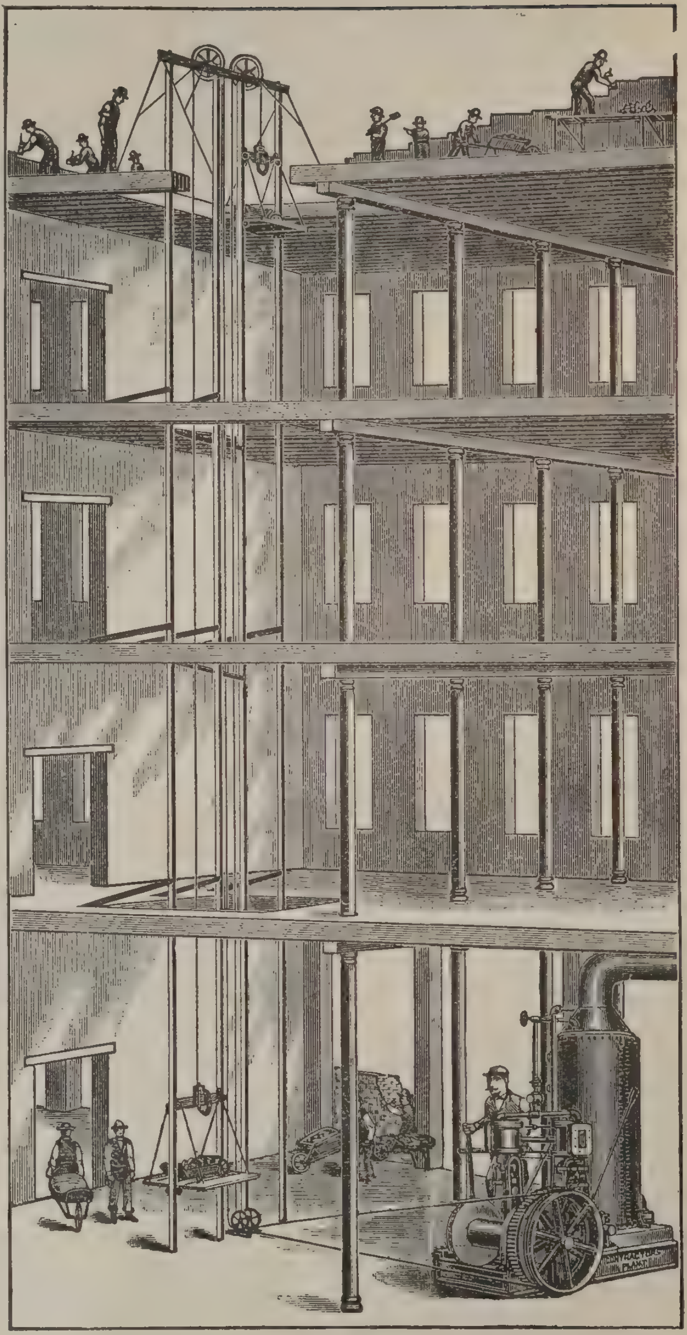
The design for the Hartford Life and Annuity Company's new building is from the office of Mr. F. R. Comstock of this city, and, to judge from the drawings, will certainly be quite an addition to the architecture of Hartford. The building is to be five stories high, and will be the first building in this city where the steel skeleton construction has been adopted.

The first story is to have two large stores, which will front on Asylum Street, and are separated by the main entrance, which is to be quite a feature of the Asylum Street façade.

The exterior of the first and second stories is to be built of Indiana limestone, and above this will be buff brick with terra-cotta bands, quoins, pediments, etc., the whole to be capped with a large projecting cornice of terra-cotta. The building will cost not less than one hundred thousand dollars.

Within the last few months this city has received three large tracts of land, accompanied by generous funds, which are to be devoted to extending the present park system; and following this we expect some extensive improvements in the immediate vicinity of these parks. Already the movement in this direction is to be seen in the block of twelve houses which Mr. George Keller has designed for the Hartford Real Estate Improvement Company.

There are quite a number of large alterations and additions to the business premises this spring, which with the usual spring work is certainly encouraging, as all the architects seem to be very busy.



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THE
BRICKBVILDER

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85
WATER
STREET
BOSTON

THE BRICKBUILDER.

AN ILLUSTRATED MONTHLY DEVOTED TO THE ADVANCEMENT OF ARCHITECTURE IN MATERIALS OF CLAY.

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PUBLISHERS' STATEMENT.

No person, firm, or corporation, interested directly or indirectly in the production or sale of building materials of any sort, has any connections, editorial or proprietary, with this publication.

THE great strides which architecture in this country has made during the last twenty years, an improvement which has been increasingly rapid with every year that has passed, have been so often the subject of comment that the fact is frequently overlooked that there are many regions where the improvement has been but little felt. The advance has naturally taken place in the large cities, and the smaller towns have followed more or less in the rear. It is the condition of these smaller towns and outlying districts which we propose to consider, or rather which we earnestly urge our readers to consider with us.

The progress we have referred to has been, by no means, uniform, even in the large cities which have been the centres of this movement. It has not only had its ups and downs, its ebb and flow, but has been accompanied by an apparent retrogression. Fifty years ago in this country there were no buildings built which can compare with the best of to-day, neither were any built which sank as low as the worst that are done to-day. The work then was for the most part on the dead level of the commonplace. Its very commonplaceness saved it from further fall. In most cases its utilitarian baldness had, at any rate, a frank straightforwardness and directness, which gave it a certain matter-of-fact respectability. Since then the advance has been so rapid that public taste has not been able to keep pace with it, and often fails to distinguish between real merit and showy vulgarity. It has, we think, been a misfortune for our progress that much good work has been so showy. The public has supposed that the showy qualities were those which were of value, and, as the vulgar work was showy also, it has been thought to be equally meritorious. In this way partly (though other causes have contributed) the very advance has been productive of a parallel retrogression. The march of the really good architects has been accompanied by a host of vulgar and untrained men, who have imitated always the faults of their betters. The half-trained and ignorant "architect," or the builder who designs his own constructions, and who satisfies the craving for novelty of his customers by distorted copies of work he does not understand, has naturally secured his strongest foothold in the outlying districts and the smaller towns. The opportunities for training and for becoming familiar with the best work do not exist there, and the echo of the progress in the cities produces simply an unreasoning and untrained craving for novelty on the one hand, while on the other, in the face of such dire results, conservatism clings to traditional and vicious methods, the outcome often of the slipshod ways of the "boom," which has ushered so many of our newer cities into being.

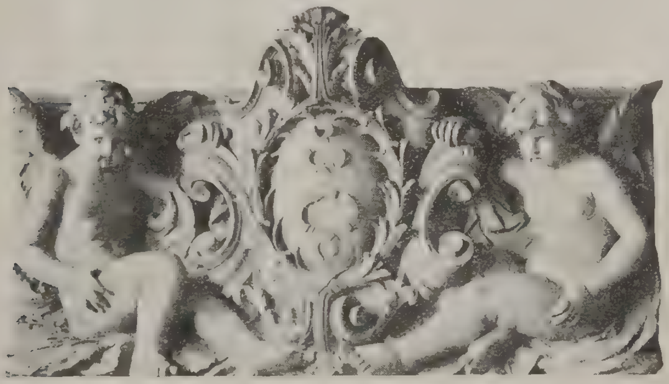
IN no other field of architecture has progress been more marked of late than in brick building, and in no other province have the unfortunate conditions we have been referring to as characteristic of the less favored localities been so prominent. We do not refer to this condition of things hopelessly. Our readers know that we do not preach the gospel of despair, but we think it is time that the people in the outlying districts should be helped to appreciate the difference between good work and bad. Missionaries are wanted, and we believe that every brick manufacturing concern might be such a missionary, and a powerful one, and might find its profit in so doing. Let us take a concrete instance. In many small towns and cities the wooden or galvanized iron cornice is the almost inevitable crown to the store front. It is often a sham cornice at a considerable height above the roof, which it is supposed to finish. The wall it crowns is a mere screen; sometimes this screen is cut up into sham gables, executed in galvanized iron. Now if our brick manufacturers would exert themselves to point out the great superiority in point of durability, of beauty, of real architectural effect of a simply treated wall with grouped openings, crowned by a brick cornice, they would not only be making a market for their brick, introducing their use where galvanized iron or wood had prevailed before, but they would be accomplishing a work of real advantage to the community. They could render enormous service in helping to improve the aspect of our country towns. Some brick companies have done much by employing expert designers and offering designs for cornices, windows, doors, chimneys, and other details, and giving the price per foot, or per opening of a given size, at which the brick for these details can be furnished. In this way it can be shown to customers what very attractive designs can be produced by the use of the simplest means and at slight expense, and the flimsy sham cornices are driven out to make way for something better. This has been done in one or two instances. But every brick concern might operate in this way in its own district, and might thus improve the standard of work so far as its influence reaches, greatly to its own advantage. Unless carried out under the best advice, however, this plan will prove utterly futile. People soon tire of crude designs which they have chosen simply for their novelty, and will begin to look about for something else novel. The really good thing will always find a market and will always be in style.

The publication by some brick companies of poor designs for architectural detail has done much harm, and in the long run has done those who promulgated them no good, while the good design is a permanently paying investment, and brings credit and business to the company sending it out. If such a plan is adopted the important thing is, as we have said, to act under competent advice. We do not intend this as an idle suggestion, but shall be glad to co-operate in any way, or give our advice to any companies who may think of adopting it. We believe the plan will pay. Such a policy might usher in a reign of simple and appropriate and charming design in the less important and less expensive buildings of the country, which would lead to still further progress. It would do no injury to architects, quite the contrary. In the first place the aim would be to reach those who had not been in the habit of employing, or were not likely to employ, trained architects, and its tendency would be, by improving taste, to educate people to a proper appreciation of architectural training. Its ultimate effect would be to encourage the employment of thoroughly trained architects on all occasions.

OUR ILLUSTRATED ADVERTISEMENTS.

THE subject chosen for illustration this month, in the advertisement of the Hydraulic Press Brick Company (see page xxi), is a view of the entrance to the upper church of St. Francis at Assisi, also the flight of steps leading to the square on which this entrance opens down to the lower square, which is on a level with the lower church. The small bell turret and the adjoining arcade were added in the time of the early Renaissance.

We were unable to procure in season for publication in last month's edition a photograph of the Wolfe Building, New York, H. J. Hardenberg, architect. Mr. John Beverly Robinson, in his article on "Recent Brick and Terra-Cotta Work in New York City" (April number), says of this building, "I think it may be considered, whether we admire it or not, the most noteworthy attempt at a design that can be found among the new steel frame buildings anywhere. An effort has been made, and I think successfully, at making a very tall building a real pleasing thing to look at."



A half-tone illustration of this building may be found in the advertisement of the New York Architectural Terra-Cotta Company (see page xx), who furnished the terra-cotta. The accompanying illustration is of a bit of detail used in the façade.

BEGINNING with this month, we shall hereafter print our plate pages on coated paper, and on one side only. These pages will be inserted loose into the journal, and there will be as a rule but six of them, although the number may be increased on special occasions.

We have every confidence that this change will meet with the approval of our subscribers, and that they will accept the reduction in the number of plates in lieu of the more desirable manner in which they will be published.

Our patrons may depend upon it that THE BRICKBUILDER will be improved month by month, and year by year, as we are able to consistently do so, as we have an ambition to make THE BRICKBUILDER eminently worthy of the materials and industries it represents.

BRICKBUILDER COMPETITIONS.

PROGRAM.

WE desire to announce a competition open to all draughtsmen who are subscribers to THE BRICKBUILDER, for a city house of brick. The house is to have a frontage of twenty-five feet on the street. The lot is eighty feet deep. The house will have four stories over the basement, and its cost must not exceed $16,000. The front will be of brick, with architectural detail of moulded pressed brick, taken from the catalogues of our advertisers, or of pressed brick and terra-cotta; colored faience may be introduced into the ornamentation if desired. The drawings will be made in line with black ink, on two sheets, cut to the uniform size of 14″ x 18″. One sheet will show the elevation at a scale of one fourth inch to the foot; the other, the plans of the first and second floors, at a scale of one eighth inch to the foot; and details of the façade (especially the cornice) at a scale of one half inch to the foot. The style of brick bond adopted must be clearly shown on the elevation. Drawings must be received at the office of THE BRICKBUILDER not later than the first day of June. THE BRICKBUILDER offers a first prize of $60, a second prize of $40, and a third prize of $20. In addition to these prizes, THE BRICKBUILDER offers a special prize of $40 for that design, *accompanied by specifications*, for a similar brick house, of fireproof construction throughout, which can be executed at the lowest cost. In awarding this special prize, only those designs will be admitted to competition which reach a certain standard of excellence in design; but beyond that, the awarding of the prize will depend on the excellence and the economy of the construction called for in the specifications. Designs unaccompanied by specifications will be regarded as being entered only for competition for the first three prizes. This special prize may be taken by one of the winners of the other prizes, or by another, as the case may be. The question of cost will be submitted to an expert builder. The prizes will be awarded by a jury of three architects of acknowledged reputation.

Each drawing must be marked with a motto or cipher, and a sealed envelope similarly marked, containing the full name and address of the designer, must accompany the drawings. These envelopes will not be opened until after the award is made.

THE BRICKBUILDER reserves the right to publish the prize designs and the prize specification. Other drawings may be published with the permission of their authors. At the conclusion of the competition all drawings will be returned to competitors. Drawings must be delivered flat, express or postage prepaid.

WE would remind those who are intending to submit designs in the competition, the programme of which is announced on this page, that it will be necessary to have all drawings reach us not later than June 1.

WE have several more competitions in contemplation, which will be of a very interesting character, and open to all subscribers to THE BRICKBUILDER. The first of these will be announced upon the completion of the competition now being held.

NEW ADVERTISEMENTS.

ON page xiv may be found the new advertisement of the Fawcett Ventilated Fireproof Building Company of Philadelphia. A full page is used in illustrating and describing their system of construction.

Another new advertisement is that of the National Brick Company of Bradford, Pa. (see page xii), for whom Charles E. Willard, 171 Devonshire Street, Boston, is New England agent. This company makes their brick from pure shale and without the use of coloring matter of any kind.

Still another new-comer with us is D. J. Curtis of Springfield, Mass. (see page xii). Mr. Curtis is one of the best known brick manufacturers in New England. The lines that he specially advertises are circular brick for power chimneys and ornamental brick moulded in sand and not re-pressed.

BRICK AND MARBLE IN THE MIDDLE AGES.

G. Edmund Street.

CHAPTER VIII. — *Continued.*

THE internal effect of the church is much finer than its west front would lead one to expect. The plan is simple, — a nave and aisles of six bays, transepts with three eastern chapels to each, and a choir of one bay with an apse of four bays projecting beyond the others. The tower is in the angle between the north transept and the nave, and a large sacristy with an eastern apse is built against the south transept. The nave and aisles measure about 230 feet by 104, and the transept 160 feet by 48, — magnificent dimensions undoubtedly. The columns are simple, cylindrical, and very lofty, their capitals carved with foliage, which looks late and poor in its execution, though grouped in the old way in regular tufts or balls of foliage. The arrangement of the wall above the main arcade is very similar to that of the Veronese, and, indeed, to that of most Italian Gothic churches; a plain wall being carried up to the groining, relieved only by a small clerestory window at the highest point. One is apt to compare this arrangement with the artistic arrangement of clerestory and triforium in our own churches; but herein we do not act quite fairly to Nicola Pisano, who is said to have designed the Frari, and his brethren. They had to work in a country where light must be admitted very sparingly, and where, therefore, it is impossible for architects to revel in the rich traceries which fill the bays of the churches of the North; they lived among a nation of painters, and deemed, perhaps, that these plain surfaces of wall would one day glow with color and with Scripture story. For these reasons, then, I defend them for the bareness and over-great plainness which are certainly at first felt to be so remarkable in their work. The real beauty of these interiors is owing, more than to anything else, I believe, to the simplicity and purity of the quadripartite groining which covers them in, and which, even where other features would seem to tell of debasement and absence of pure feeling, invariably recalls us to a proper recollection of the infinite value of simplicity in this important feature, — a point lost sight of in England after the thirteenth century, to the incalculable detriment of the beauty of some of our greatest churches. It is not difficult to prove that this must be the case, for I take it for granted that we all feel that ornament for its own sake is valueless; and equally, that doing in a troublesome, and therefore costly, way that which may be done as well and as strongly in a simpler manner, is unpleasant and distasteful as an exhibition of the wasteful expenditure of human skill and energy, and therefore as simple quadripartite groining with diagonal and transverse ribs, and no lierne or intermediate ribs, is quite sufficient for the construction, and as the vaults are in no degree whatever strengthened by the multiplication and ramification of perplexing ribs, such as we see in later days in fan tracery and other contemporary modes of vaulting, that it is the truest and most agreeable system of roofing in stone.

The simple groining of the Frari is entirely executed in brick, and springs in the aisles from pilasters corbelled out of the walls midway in height, just as in Sta. Anastasia at Verona, and in the nave and choir from clusters of shafts rising from the caps of the columns.

The apse is the noblest feature of the whole church; its windows, with their singular and not quite pleasing transom of tracery, are refreshing because they have tracery, though indeed it is of a rude and heavy kind.

There is something impressive about the arrangement of the church. The choir is prolonged by the length of about one bay and a half into the nave, and fenced off to the west by a great screen, surmounted by figures of the apostles, with a crucifix resting in the centre. The nave is, of course, quite free from any fixed seats, and this, with the great area of the transept and the fine perspective of the long range of seven apsidal chapels on its east side, gives a grand air of spaciousness to the whole interior. There are some fine monuments here, quite worth notice as very characteristic of Italian art. They are generally high tombs corbelled out from the walls, with arched canopies over them, enclosing paintings. Here the south transept wall over the door to the vestry contains a group of such monuments, which is extremely picturesque. The monument of "Beatus Pacificus" (A. D. 1437) has a graceful painting of the Annunciation over its arch, and sculptures under it of the Baptism, and, on the tomb, of the Resurrection and the Descent into Hell.[1] Another monument has a life-size figure on horseback, and all have so much freshness to an English eye, and yet so much identity in principle with our own old monuments, that they are well worthy of study. Last, but not least, are two immense monuments facing each other, near the west end of the nave, to Canova and Titian, preposterous in size, heavy, ugly, and cold in character, quite unsuitable to a church, and, so far at least as I could judge, entirely devoid of merit as works of religious art. There is, too, a painting by Giovanni Bellini of the Madonna and Saints, which ought to be visited, in the grand and well-used sacristy, — a room such as one never seems to see save in Italy. It is still in its old frame over the sacristy altar. Both in artistic interest and in religious effect it is perfectly fine; the subject — a Madonna and Child, such as Gian Bellini alone could paint. Angels playing instruments, sweet and pretty in character, and saints full of reverence and awe for our Lord, all treated with a color of exquisite depth and richness throughout, make this as worshipful a picture as I know. There is also in the north transept a most elaborately framed Gothic triptych, with figures well drawn and rich in color.

The stalls in the Frari are all placed in the nave west of the transept, as in Westminster Abbey. They are of very rich Renaissance character, but with some late Gothic features. In the north transept is some elaborate Gothic panelling — very German in character — which looks as if it had come from the back of the old choir stalls. Here, too, is a crucifix, probably the original rood. Some fragments of stained glass are still visible; they are coarse and rude in detail, but extremely fine in color, and one must picture the church full of rich glass in order to do justice to the scheme of the mediæval architect.

To the south of the nave are large uninteresting cloisters, and it is only at the east end that the exterior at all repays the ecclesiologist for the pains he must take to get all round it. The view which I give will best illustrate its general character. The windows are all transomed, the tracery and portions of the arches being executed in stone, the rest of the wall being entirely of brick or terra-cotta with some red marble in the eaves arcading; the bricks are not particularly good, and the terra-cotta borders, cornices, and ornaments are poor and meagre in their design. The most observable point about the detail is the great and ugly splay on the exterior of the windows, and the facts that the window mouldings are returned round the sills, and that all the apsidal terminations in the church finish with an angle in the centre, — a peculiarity which is very seldom met with, but very much to be commended as variety.

There is a degree of clumsiness about the way in which the arches of the windows are set upon the jambs which is very characteristic of Italian Gothic; but this, and other points open to criticism, do not prevent the east end of this church from being a very noble conception, broad and grand, unbroken with the lines of buttresses, which generally too much confuse apsidal terminations, and yet very vertical in its effect. There is no petty attempt at relieving or ornamenting plain wall where it occurs, but it is left in the native rudeness of the rather rough-looking red brick, which is in no respect better than the bricks one may get anywhere in England. The cornices are very marked, and those in the clerestory have the common and ungraceful corbelled arcading in brick, to which I have a special antipathy. The clerestory windows of the transepts and choir are, I need hardly say, quite modern, and of a kind unfortunately most popular throughout the North of Italy. North of the choir is a tall brick campanile, leaning rather dangerously to the north, finished with an octagonal upper stage, and, though not very remarkable, making a conspicuous feature in most of the views of this part of Venice, and at any rate to be admired for its simplicity and the absence of effort in its design.

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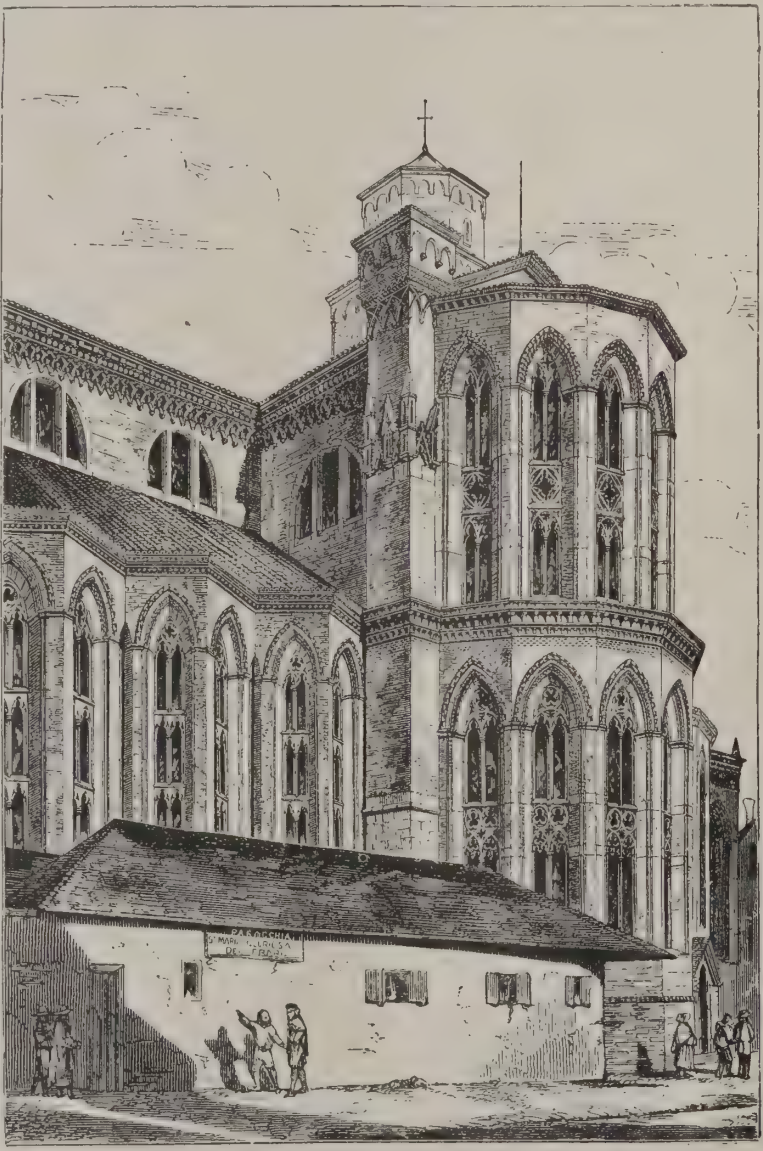
[1] The crockets on the monument of A. D. 1437 are exactly similar to those on the western gables of St. Mark's, and prove that these are of about the same date.

Next in order of merit to this church are those of SS. Giovanni e Paolo and of the Madonna dell' Orto, both of them savoring most strongly of the influence of the Pisani, and in very many points remarkably like the church of the Frari.

We will take SS. Giovanni e Paolo first. The plan is of the same sort as that of the Frari, — nave with aisles, and transepts with two chapels opening on each side of them. These are all apsidal, but planned in the usual way and not as at the Frari. The east end is a fine composition, having an apse of seven sides, and is the only part of the exterior to which much praise can be given. It is divided into two stages by an elaborate brick cornice and a good balustraded passage in front of the upper windows. The traceries are all unskilfully designed, and set back from the face of the wall with a bald plain splay of brickwork around them; the lower windows here have two transoms, and the upper a single band of heavy tracery which performs the part of a transom in an ungainly fashion, though not so badly as in the great south transept window in the same church. Here, just as at the Frari, it is obvious that the absence of buttresses to these many-sided apses is the secret of the largeness and breadth which mark them; and, to say the truth, not only are large buttresses to an apse often detrimental to its effect, but at the same time they are very often not wanted for strength. The interior is remarkable on account of the fine scale on which it is built, and for the large number of interesting monuments corbelled out from its walls. Many of them are mediæval and rich in sculpture of figures, not only on the tombs themselves, but again in the face of the wall, around their canopies. The effigy of the deceased is almost always placed on the top of the high tomb or sarcophagus, which, in order that it may be visible from below, is made with a slope towards the spectator, the effect of which is most distressing. Much more beautiful generally is the curtained tester often put above the figure, on either side of which guardian angels, holding back the folds of the draperies, allow us to join them in looking at the figure on the tomb. There is here a very fine lectern — a double-headed eagle standing on a scorpion — with a rich mediæval stand and base.



STA. MARIA GLORIOSA DEI FRARI, VENICE.

There are small two-light windows just over the arches in the nave which take the place of a triforium, and which look almost as if they were the clerestory windows of an earlier church whose arches were much less lofty than those which now exist.

In the small piazza in front of the church stands one of the glories of Venice, — the monument of Bartolomeo Colleoni. As is the case with too many equestrian statues, the base seems dangerously small for the steed, slow and stately as his movement is. What a grand air of valiant determination this old warrior wears! what a serious purpose the artist had in his work, and how carefully he has rendered every detail of trapping and armor on both man and horse! We have already heard of this famous *condottiere* in his chapel at Bergamo and his castle of Malpaga. His statue was the work of Andrea Verocchio, but was completed by Alessandro Leopardi, between 1479 and 1488. Colleoni had left his whole fortune to the republic of Venice on condition that his statue should be placed in the Piazza of St. Mark. This being contrary to the laws, an ingenious loophole for escape was discovered: the bequest was secured by the erection of the statue in front of the Scuola di San Marco, whose strange Renaissance front (built with colored marble in a horrible sort of perspective, which is the lowest depth to which architecture ever reached) stands at right angles to the front of SS. Giovanni e Paolo. For any one who wished to be remembered near St. Mark's church, the catastrophe would be as great, if he cared about art, to find himself connected instead, with such an abortion as the Scuola of that ilk, as it would be to Bartolomeo Colleoni to find himself here in the suburbs when he stipulated so carefully for a place in the very centre of the city!

(*To be continued.*)

GLAZED BRICK.

BECAUSE a glaze is a good glaze on certain classes of clay goods, it by no means follows that it is equally serviceable on other clays. Indeed, it is extremely unlikely. We have never met with a glaze so accommodating as this yet. What is the reason? Simply this. Different substances contract and expand at different rates when exposed to various degrees of temperature. The difference between the expansion of a given bulk of iron at 500° C. and a similar bulk of copper at the same temperature is very marked. It is the same for other materials, and is especially remarkable in connection with clays.

Clay A expands or contracts in kiln at a certain given rate; clay B exceeds that rate; therefore if a glaze suits clay A, it certainly will not suit clay B: for glazes expand and contract as well as clays, and if a glaze suits a clay it is because this physical quality of expanding and contracting is possessed by the glaze to the same extent as it is by the clay.

If glaze and clay contract or expand unequally, the former will crack and may even chip off. The proper thing to do, therefore, is to study the composition of the glaze and also of the clay, and endeavor, by altering that of the glaze (one cannot easily alter that of the clay), to bring its contraction and expansion into harmony with that of the clay. — *British Clayworker.*

THE ART OF BUILDING AMONG THE ROMANS.

Translated from the French of Auguste Choisy by Arthur J. Dillon.

CHAPTER II. — *Concluded.*

SPECIAL CASES IN THE CONSTRUCTION ON VAULTS; MEANS OF STRENGTHENING; BUTTRESSES, ETC.

THE walls of the Pantheon form a continuous drum about the edifice, and are lightened by two stories of interior cells, whose arrangement I have endeavored to show by drawing them partially denuded of the revetment that closed and concealed them. Between these spaces for lightening the wall other cells were built in the form of vaulted niches, with their convex surfaces turned in the direction from which the thrusts would come. Barrel vaults, or half-cylinders vaulted by quarter-spheres, such were the usual forms of the cells which the Romans built in the midst of the walls that received thrusts: we shall see them in the piers of vaults and find them again in retaining walls (Plate XIV., Fig. 1). Everywhere their *rôle* is the same: they increase the total thickness or bearing and add to the stability, without increasing the expense to any noticeable degree.

At the same time that the Romans sought to maintain their vaults by great masses of masonry, they also sought to render the thrusts less dangerous by using in their construction materials of very little weight. The use of lava in ancient vaults was very usual; and the large number of instances of its use at those points where lightness was so desirable a quality prohibits us from regarding its presence as accidental. The greater part of the vaults of the Coliseum, and those of the Baths of Titus and of Caracalla, are built of volcanic tufa that is very porous, and all compact or heavy stone is carefully excluded; and a note, in the compilation of Isidore of Seville, very probably taken from some Roman writer, plainly shows that the custom was to reserve the lightest materials for the construction of vaults.[1]

There is one matter of detail often connected with this idea of lightening the vaults whose importance is, in our estimation, exaggerated. It is the presence of vases of clay in the rubble.

The small space, compared with the total volume of the vaults, which these vases occupy, and especially the places where they are found, tend to make us believe that their use was not because of their lightness. In fact, if the ancients had thought that the placing of the vases in the midst of the vaults was a means of lessening the thrusts, we would find them near the summits, that is, where weight was most to be avoided. This is the contrary to what really exists in the greater number of cases. The positions of the vases can be observed in a monument of the fourth century, which, on account of their presence, is called the Torre pignattara. Vases of terra-cotta can also be seen buried in the vault of Minerva Medica (Plate XI.), and I was also able to study the position of these vases in a number of tombs along the Via Labicania, and more especially in the Circus of Maxentius, outside the gate of St. Sebastian; everywhere I found them gathered near the flanks of the vaults. Plate IV., Fig. 1, shows how they were used in the last-mentioned case. Sometimes they are over the vault itself, but more ordinarily they lie directly over the solid walls that form the piers, and are most numerous at just those points where their lightness was of no advantage. I have even found them in the body of the walls. To give one example out of many, if one examines the façade of Minerva Medica he can see, on the right, a little above the archivolt of the door, one of these vases buried in the rubble wall, just behind the exterior revetment. In a word, the distribution of these vases is such that any theory that their use was due to calculations based on the advantages arising from their lightness is out of the question.[2]

The origin of their use was probably this: liquids were constantly being brought to Rome, for the alimentation of its inhabitants, in vases of baked clay. The Romans had nothing to export in them in exchange, and consequently had on their hands a large number of old vases of large size and of small value. They got rid of them, it is thought, by throwing them, as being useless, in the place that to-day bears the name of Monte Testaccio; the fact is at least that the hill thus called is formed entirely of *débris* of Roman pottery. It must have occurred to the builders to utilize these vases as building material; they were as good as stones of good quality, and, in equal volume, certainly were not more expensive than the broken stone for which they were substituted. On account of their lightness they were placed, in preference to ordinary stones, in the upper parts of the buildings, being easier to lift; but the idea of using them to reduce the weight and hence the thrusts of the vaults does not seem to have occurred to the Romans. We find this idea put into practice in the Lombard buildings at Ravenna and Milan. I do not know whether the Lombard architects invented the vaults without thrusts which they obtained by means of the vases, but it appears at least very probable that they did not borrow the idea from the Romans. It seems more likely that the methods used in the dome of St. Vitalli were brought into Italy by the same route as the architecture of the edifice; and under this hypothesis the honor of the first logical application of pottery in the building of vaults belongs entirely to the architects of the Byzantine school.[3]

Moreover, if one considers only truly Roman buildings, the use of hollow vessels is but a secondary detail of their history, and an investigation of the ancient uses of this form of baked clay in construction gives no important conclusions nor reveals any facts capable of completing or of showing more plainly the principles developed in the course of this study.

One of the last figures (Fig. 54), a Roman hall seen from the exterior, shows a remarkable peculiarity of the ancient vaults. It is that the vaults themselves form the roof of the edifices they cover: one never finds the vaults covered with a wooden framing or gable. It seemed to the Roman builders that to protect a vault of masonry with a roof of wood, a costly, unsubstantial material of short duration, was a useless combination, and that it was to do work for the same end twice over; either they used roofs of wood, without vaults, or they used a system of vaulted construction, in which case wooden roofs were excluded, and the vault alone served all purposes; on its extrados were placed the plates of metal or the tiles that shed the rain; and sometimes the masonry, levelled like a terrace, has no other protection than a bed of fine compact *béton* (Fig. 57).

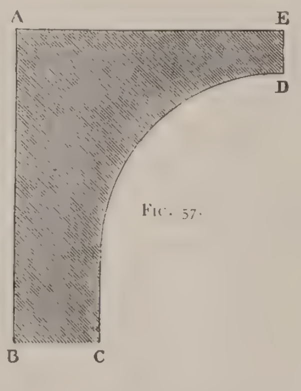


Fig. 57.

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[1] "Sfungia, lapis creatus ex aqua, levis ac fistulosus et cameris aptus." Orgin., lib. XIX., cap. x.

[2] One might perhaps think, when seeing this pottery used in ancient buildings, of those vases of clay which, according to Vitruvius, were used, together with metallic vases, to make halls used for large assemblies more sonorous; but the similarity is, I think, quite accidental. The desire of increasing the effect of the voice can be understood in the case of theatres and such buildings; but in the tombs, such as the Torre pignattara, or in those along the Via Praeneste, this quality of sonority evidently has no place. Moreover, Vitruvius does not say that the acoustic vases were built into the walls of the theatres; they were only placed under the seats; so that from no point of view does an analogy between the two kinds of vases seem admissible.

[3] See for the description of vaults built of hollow tubes laid in mortar the work of M. de Dartein on Lombard architecture. M. de Dartein, who kindly allowed me to use the results of his researches, in order to assist me in clearing up the origin of vaults built of clay vessels, believes that the use of this system of construction goes back to at least the fourth century; and has verified his view not only in St. Vitalle at Ravenna, but also in the Baptistery of Ravenna, restored and decorated by St. Neon (425–430), and in the ancient chapel of St. Satyre, near the church of St. Ambrose, in Milan.

A whole series of vaults in the Baths of Caracalla belongs to this type; they terminate in an almost horizontal surface, and the last course of masonry, covered with a mosaic of colored marble, forms the floor of a magnificent terrace.

In the other case, where the vault is covered with tiles of metal, it ordinarily has the form of a gable roof. There is a remarkable instance of this in the church of St. Maria Maggiore (Fig. 54). The interior is a series of intersecting vaults; and if one will imagine each as being covered with its own roof, he will obtain the exact idea of the shape of the exterior, the valleys corresponding to the groins. Of all possible solutions this is the most natural and the one that gives the best flow for the rain water. Similar solutions can be seen in the Baths of Paris, in the Basilica of Constantine, etc., differing only in that the spherical vaults are finished on the exterior with convex surfaces, as in Fig. 58. This exception is justified by the fact that in order to obtain a plane surface it would be necessary to use additional masonry amounting to an increase of considerably more than half. The Romans thought this out of proportion to the results, and it was one of their most marked traits that they knew where to stop when following out a series of ideas or principles, whose resulting practical rules would lead to extremes if rigidly observed.

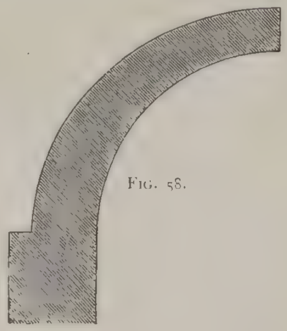

Fig. 58.

The last question, of how the vaults were maintained, remains to be taken up, together with the questions of what brought about the ruin of those that have fallen and of what means were used to repair, or to prevent the complete destruction of, those that were partially ruined during the time of the Romans.

Among the causes of rupture to which vaults of concrete were exposed we must first mention the sudden movements or unequal settling of the soil. Then comes a cause that seems very insignificant, but one which the ancients considered quite serious, the destructive action of the roots of large vegetable parasites, growing in the interstices of the masonry. From all time the Roman laws sought to prevent this danger by fixing the distance at which plantations could be placed from aqueducts, which were the works where fissures were most to be dreaded. As soon as the year 11 before our era, a decision of the Roman Senate prohibited planting within fifteen feet of aqueducts; this prohibition has been transmitted to us in the treatise of Frontinus on aqueducts, and three centuries later we see it confirmed and emphasized in the Constitutions of Constantine.[1]

The danger that they sought to prevent was really serious; one can hardly imagine what great masses can be moved by roots in the course of time, and it would not be far wrong to estimate the ruin brought about by this obscure cause as equal to that due to man.

Whatever may have been the cause of its rupture, a Roman vault was repaired by lining it with an inner vault of brick, laid with radiating joints. In the environs of Rome there are several instances where aqueducts have thus been repaired by inner vaults that made up for the inability of the original armatures to carry the masses of rubble; the second figure of Plate XIV. shows one of these aqueducts strengthened after building; the arcade in which I found the facts for this drawing is one of those near the platform of the Lateran; its ruins are almost immediately behind the chapel of Scala Santa.

The method was as simple as it was ingenious. The vault intended to support the ruptured one was built without endeavoring to consolidate it with the first one; on the contrary, a space was left between the ruptured vault and the strengthening one, walled up at one end, so that there was left a sort of cylindrical chamber which was afterwards filled with well-rammed *béton*, that formed a bed between them.

Such was the method; sometimes it was simplified by building the strengthening vault without placing a bed of mortar between it and the ruptured one. It was thus, I judge, that several of the monuments of Pompeii, damaged by disturbances before the great eruption, were repaired; the Baths and the Ampitheatre were perhaps among these. And I will also cite an ancient vault, known only through an inscription, which was, according to it, "propped up by supporting arches" of double thickness and carried on special piers. (Orelli, no. 3328.)[2]

The arches in Pompeii might strictly be given another function, but the document I have just given makes it useless to enter into a discussion whose result would be doubtful at the best; for though there may be some question of the arches in Pompeii, it is at least certain that exactly similar ones were used by the ancients to prevent the fall of ruptured vaults.

(*To be continued.*)

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THE CONKLING-ARMSTRONG COMPANY, Philadelphia, have secured the contract for terra-cotta on the Horticultural Hall in that city, Frank Miles Day, architect. Pompeian terra-cotta will be used.

THE new catalogue which The Conkling-Armstrong Company are about to issue will be quite an elaborate affair, being so constructed that additions may be made to it from time to time of photos of such work as the company may produce.

THE large contract for furnishing the enamelled brick to be used in the construction of the new Guaranty Building, Buffalo, N. Y., has been awarded to the Tiffany Pressed Brick Company of Chicago.

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[1] Frontin, De aquaed., n. 126 and 127. Cod. Theod., lib. XV., tit. II., l. 1. Cf. Cassiod., Variarum, lib. II., ep. 39; lib. V., ep. 38; lib. VII., form. 6. Compare these remarks of the ancients with those that L. B. Alberti gives in the sixteenth chapter of the tenth book of his work "De re aedificatoria."

[2] These are the words of the inscription: "Albinus . . . cellam tepidarium inclinato omni pariete labent, de qua cellarum ruina pendebat erectorum a fundamentis arcum duplici munitione fulcivit."

ON THE USE OF BRICK IN DOMESTIC ARCHITECTURE.

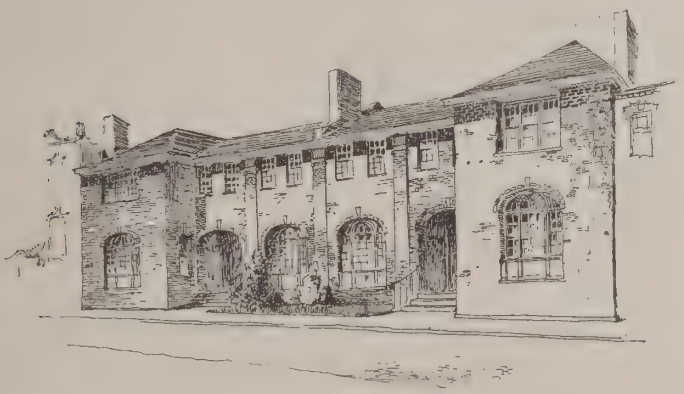
II.

BY RALPH ADAMS CRAM.

WORKMEN'S COTTAGES IN CITIES.

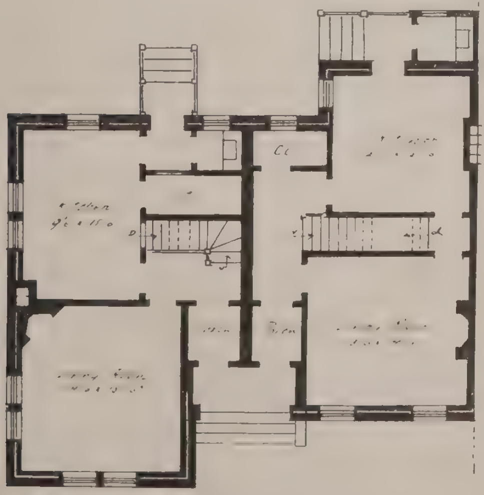
IN a former article I attempted to make some suggestions towards a reform in the humblest class of domestic building, viz., in workmen's cottages to be built in small villages; in this paper I wish to consider the same class of work in cities.

All that I said before in the matter of the false economy, artistic degradation, instability and moral injury of the ordinary wooden tenement or cottage holds in the case of city work of a similar nature. To be sure, the restrictions which surround city blocks prevent such a degree of artistic horror as obtains in country work, but if the æsthetic depravity is less aggressive, it is just as destructive in its passive aspect, and so the ordinary blocks of barren face brick, disintegrating brownstone, and crazy galvanized iron are just as immoral, just as mentally injurious to the unfortunate occupants, as the more ambitious and therefore more aggressive wooden absurdities that desecrate our modern villages and city suburbs.



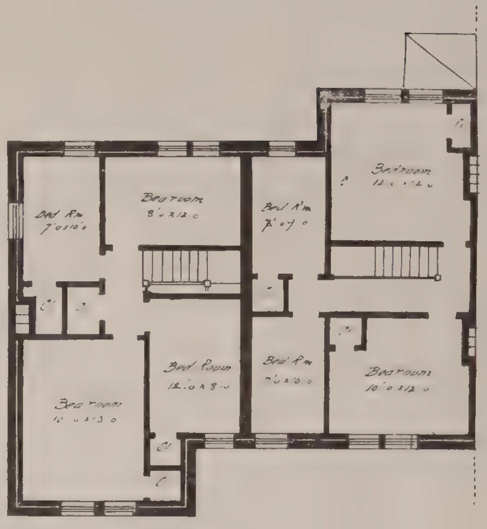
Now this condition of things is unnecessary. Blocks of small houses can be built well, and with some element of beauty, for the same amount of money that is wasted on face brick horrors with galvanized iron bay-windows; all that is necessary is a little intelligence in the matter of economical planning, a little regard for beauty, and some slight knowledge of how to spend money for ornamentation that will ornament. You can't make a brick wall with holes in it beautiful by putting a crazy galvanized iron bay-window on it, and crowning it with a false gable of the same disgraceful material; neither can you add to its attractiveness by sticking a few pieces of quarry-faced brownstone into it, varying its red monotony with scrofulous "Roman brick," and rendering it a public nuisance by filling its front door and its transoms with crude blue, orange, and magenta glass. Thus far goes the resourcefulness of the ordinary builder, and no farther, and the immoral results we have with us always.

What is the alternative? What can we do to make a block of cottages no less expensive, though more honest in construction and more artistic in effect?



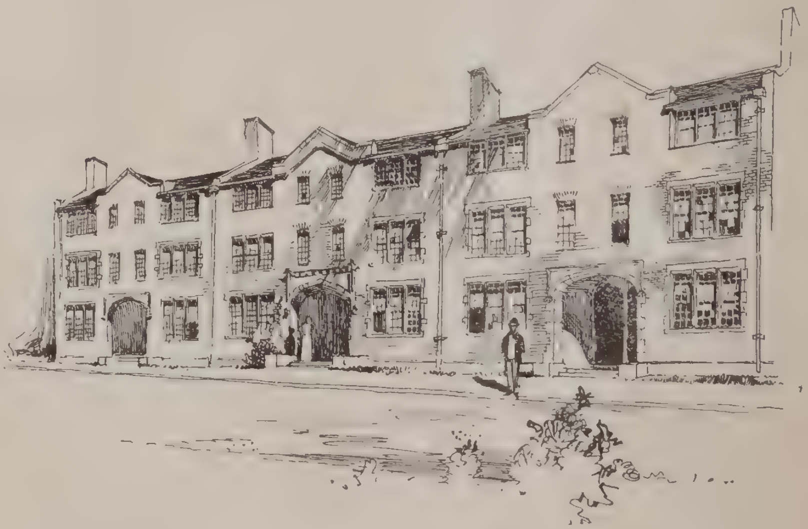
Plan of First Story.

First of all we can provide economical plans. The actual area of the houses illustrating this article is about eight hundred square feet each. They are twenty feet wide, and would go on lots from forty feet to fifty feet deep, each having a small back yard, the grass plot in front varying with the depth of the lot. One of the blocks, that of four houses, would be but two stories high with an unfinished cellar, the other three stories high. The two-story cottages would contain a living-room, dining-room, and kitchen, and four bedrooms, with an unfinished laundry in the basement. The three-story cottages would contain six bedrooms and a bath, instead of the four of the two-story plan. From eighty to one hundred houses of this nature could be built on an ordinary city lot of two hundred and fifty by five hundred feet, the number depending on the amount of land reserved for a park in the centre of the block, in place of the useless and generally unsightly grass plots in front. The cost of such structures would be exceedingly small.

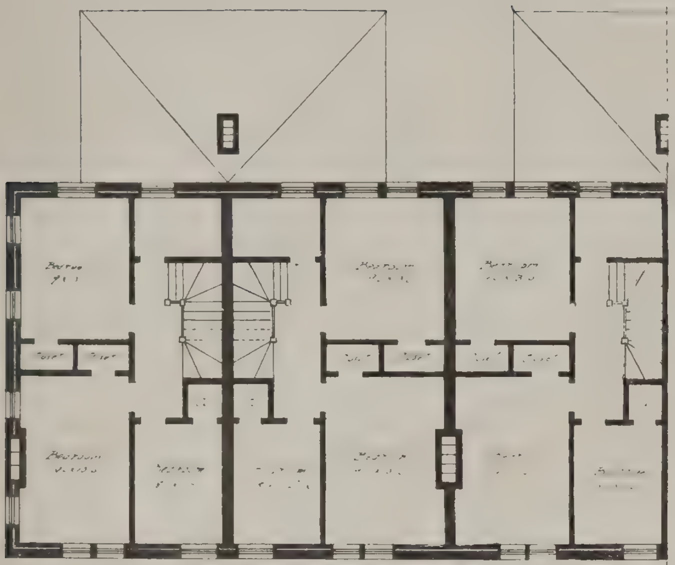


Plan of Second Floor

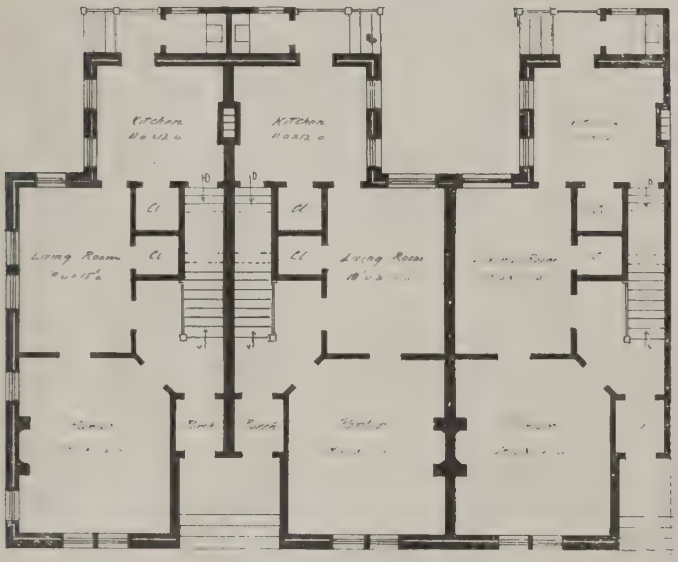
The external treatment should be of the simplest nature, the effect of the houses depending on their proportions and delicacy of such detail as they might have, — a principle now apparently entirely forgotten, but which should hold in more ambitious work as well. The plans shown for four-house blocks have the simplest possible colonial exterior, the effect being obtained by recessing the two middle houses, by the range of plain elliptical windows, and by the brick pilasters breaking up the recessed portion. The material used is common red brick laid in English bond with white mortar; the sills are plain slip sills of Vermont white marble; while the cornices, pilaster caps, and window details are of wood, painted ivory white. The roofs are covered with copper, and the steps are of Vermont marble. Inside, the finish is plain, natural wood, cypress or Washington cedar and whitewood, no *papier-maché* or colored glass being allowed. The floors and stair treads are of rift hard pine. Above the first story mill doors and windows are used.



In the exterior of the six-house plan the same common red brick is used, laid in Flemish bond, the trimmings being of gray terra-cotta.



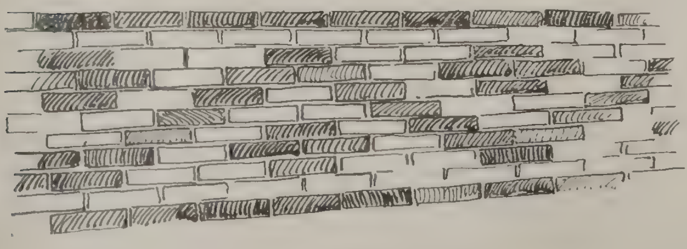
Plan of Second Floor.



Plan of First Floor.

The interior treatment is similar to that of the other design, except that black cypress, finished natural, or Canadian elm, stained dark brown, is used in the hall and living-room, an oak floor being provided in these two rooms.

It is a question whether houses such as these would appeal to the class for whom they would be provided, owing to their extreme simplicity of design, the malignant influence of the ordinary tawdry block having been dominant for so very long. I think they would, particularly if they were built as they should be, solidly and honestly. I doubt if all the unfortunates who accept the building abominations really like them; they take them because there is nothing better.



A SIMPLE BRICK DIAPER.

MESSRS. FISKE, HOMES & CO. make a most elaborate display in their Boston office of the effects that may be obtained by the use of the various colored brick in diaper patterns and frieze work.

TERRA-COTTA OR STONE?

BY THOMAS CUSACK.

IN the first instalment of Mr. Beverley Robinson's appreciative review of "recent brick and terra-cotta in New York City," attention is very properly directed to the Wolfe Building at the junction of Maiden Lane, William and Liberty Streets. Here the architect, making virtue out of a necessity, has created a picturesque structure of a dozen stories on a site as cramped and awkward as any on Manhattan Island. True, Mr. Hardenbergh is not a man accustomed to succumb to circumstances, but on this trapezium he had an unusually obdurate and intractable subject to subdue. His acceptable solution of the problem has been attested by fellow-architects, and their favorable comments will be confirmed by most people who are able to understand the difficulties with which he had to contend.

Mr. Robinson's detailed criticisms bear evidence of thought and deliberation, presumably in front of the actual building as it now stands. This much is obvious from a reading of his article. Yet he came away under the impression that the whole of it was "red brick with light colored stone trimmings," and regretting, as well he might, that "the adornments were not of terra-cotta." He will be pleased to know that there is no occasion for regret on this point, and to that end I hasten to assure him that more than nine out of the "*twelve stories with a great abundance of stone trimmings throughout, quoins, voussoirs, beltcourses, colonnettes, copings towering upwards, with crowstepped gables and dormers, balconies and bays, all most skilfully and logically worked out*," are indeed terra-cotta. Had this not been so, then there would have been one more added to the long list of similarly neglected opportunities. Mr. Robinson may extract some comfort from the further thought that he is by no means the first or only man who has been, and who will be, led to a wrong conclusion by cursory observation of the terra-cotta on this and many other downtown office buildings of note, to say nothing of some uptown residences to which I may have an opportunity of referring him.

A few weeks ago the present writer, accompanied by a candid but hypercritical friend, made an inspection of this very building, affording as it does a good average specimen of terra-cotta work in the year 1895. The gentleman in question had, in early life, been an expert foreman stonecutter, but during the past twenty years has been the moving spirit in two of the chief terra-cotta works in England. He at first hesitated to believe that the work on the Wolfe Building was terra-cotta at all, and finally failed to draw the line of demarcation between it and the two first stories, which *are* of stone. This from a practical prosaic Briton, with all the prepossessions of his countrymen thick upon him, might be thought praise indeed. But the fact that terra-cotta can be made undistinguishable from stone is *not* its chief recommendation, as I will endeavor to show presently. At the corner of Nassau and Spruce Streets we came to another and much larger operation in terra-cotta, the American Tract Society's Building, by Mr. R. H. Robertson. In front of it stood two working brick masons, engaged in an animated discussion as to whether the upper sixteen stories (a portion of which had then been erected) were stone or terra-cotta. One of them, as a final master stroke, attempted to silence his more dubious comrade by declaring that he *ought to know*, as during the past month he had been working on the job, and that the work had been delivered from day to day by the trucks of the New York Architectural Terra-Cotta Company. This man was right, so it had; and so also had the work made by this company been delivered on the Wolfe, the Manhattan Life, and many of the towering office buildings that more than any other thing excite the wonder, if they do not always compel the admiration, of foreign and domestic visitors. The man of British birth came and saw, and — got flabbergasted. While reluctant to believe that he had anything to learn about terra-cotta making *this* side the Atlantic, he appeared a good deal perplexed with his first object lesson. There will doubtless be other and similar guessing competitions before the end of the year, in New York and elsewhere. When the work now under way by this company alone comes to be submitted to architectural and technical criticism, it will be seen how great has been the progress in the art and science of this important industry during the past two years. But it is no longer a question of imitating the texture of stone, or of matching it in color. To do this with ease and certainty is now considered a matter of course, but it is not, and ought not to be, the ultimate aim of those engaged in its manufacture. A further step has been taken, and that step is in the right direction. We are on the threshold of a new era in the production of colors, and tints of color, that cannot be procured in any of the building stones in general use.

Architects who have long craved for more cheerful and harmonious color combinations were restricted to a choice from three or four available building stones. As often as otherwise, it was "Hobson's choice" with them. The one under which they were prone to take refuge is perishable within thirty years, as is painfully apparent on walking through any of the sombre brownstone districts of even more recent date. Lake Superior redstone followed as a substitute, but it bleaches and loses its color, and is but little better in point of durability, as may be seen, for instance, on the ten-year-old portico of the Murray Hill Hotel, and other discouraging examples. Beyond these we have little save marble and Indiana limestone, the latter becoming monotonous from a too general and indiscriminate use. Granite will hold its place for basement stories, polished ashlar, columns, and special features where crushing weight has to be sustained; but it will always be shut out from general use by the cost of manipulation, except in the form of ashlar or quarry-faced monoliths.

The bulk of the twentieth-century architecture must inevitably be terra-cotta in its main features. The steel skeleton construction has already afforded unlimited opportunities for its use, and will continue to give a tremendous impetus to its further development. Those who have studied the skyward tendencies of all city work are getting equipped to meet the growing demand for a polychrome building material that can be relied upon to keep its color. This demand is taking the form of constructive as well as decorative qualities, and of an enamelled as well as of a non-reflective surface treatment. Every day brings improvements in the manufactured article. These are noticeable in color, texture, reliability in burning and mechanical fitness, until we are now reaching something of an exact science. The demand for a really first-class article has kept pace with the ability of the makers to supply it promptly or under a reasonable time limit. This has in turn brought into existence a new community of terra-cotta workers. We are now getting a staff of trained draughtsmen who are of necessity something more than picture makers, and of experts on special methods of construction, based on the requirements of each case as well as the exigencies of manufacture, and who make these branches their life's study. Inducements have been offered sufficient to attract modellers from the best schools in Europe, and work is being turned out that equals if it does not in some respects surpass the hitherto matchless examples of Italy's Renaissance. Carvers in stone have thus been forced by competition and comparison into a keener struggle for existence. Nothing of any importance in this line is now attempted until it has first been modelled in clay and approved. From this a reverse is taken in plaster from which a cast is made also in plaster, and this is set before the carver *as a model* which he endeavors to imitate in stone, with varying success. There have been instances where this work was done in a terra-cotta works under the direction of the architect, and when complete the models were sent to building for the guidance of stone carvers. The general run of carving is stiff and mechanical, and the best specimens too often lack feeling and flexibility, and that indefinable touch, for which no better definition has been found than the very liberal one of "artistic merit." One thing is certain, that the work of the modeller reaches more nearly the perfect thing when from a plastic state it leaves his hands and slowly stiffens, passing through the fire without transfer or subsequent manipulation.

That timely and telling article in last month's BRICKBUILDER by Mr. George M. Fiske, in which he calls the attention of architects and others to the almost inexhaustible range of colors now at their disposal, is worthy the attention of those to whom it is addressed. It is to their own advantage to keep in touch with the higher aspirations of the building public. There is room here for the expression of taste and fitness, where these can be embodied in an imperishable material, and at a cost formerly paid for rectangular openings in a brick wall. The four-inch veneer of "face-bedded" brownstone showing unmistakable signs of lamination is no longer a guarantee of respectability. Mr. Fiske (if I mistake not) is himself a veteran clay-worker, who has gone unscathed through the fiery ordeal of terra-cotta making during the doubtful years that followed its birth as an infant industry (now no longer needing special protection). His remarks do not indicate any desire to rest on his laurels, much less to retire from the race; rather a tendency to press onward and upward, in pursuit of architectural customers as progressive as himself. He asks them to test the further possibilities of clay, and appears willing to satisfy all legitimate demands in the direction of "fireflashed" bricks, etc. It is truly refreshing to know that he repudiates all partnership with paint and painters. These have their use elsewhere, but genuine terra-cotta has no use for them. They have been called into requisition before now, and an architectural journal that should have known better gave publicity to some pages of sophistry intended to palliate, if not to propagate, their universal application; but shams and subterfuges could only lead their apostles to certain disaster. Those who resorted to these and similar makeshift methods of producing terra-cotta while diligently digging their own graves, and making involuntary confession of their failure, were at the same time storing up a legacy of doubt and derision, from which the business in general has suffered, and from which it has not yet fully recovered. Verily in this as in other things "the evil that men do lives after them."

It is only fumblers who resort to fakes. Capable manufacturers succeed best without them, and they should at their next convention take a solemn pledge against such practices. Terra-cotta is not an artificial stone, or an imitation of anything. It can claim recognition on its own inherent merits, and without disguise of any kind. It *can* be made of even color, and homogeneous throughout, and for special requirements it can be vitrified to any extent. What more need be askd? As well "paint the lily or gild refined gold." Weather-proofing it with some occult pigment under any other name will smell as malodorous. It will spoil its texture, obliterate the emblems of its plastic origin, filch away its good name, and rob it of that charm which gives it character, and which belongs to it by rightful inheritance. Badly made terra-cotta is bad for everybody, irrespective of who bears the odium of being its godfather. By the same rule a well-done job is a universal benefit, no matter who may be entitled to the credit of having stood sponsor for it. The better the work the more will it be used, and the wider will be the advantages that accrue. Thus does the question become one of public concern. Its enemies are of its own household. It lies with the manufacturers of terra-cotta themselves more than with any other part of the community to hasten or retard its manifest destiny as the popular building material of the future. The order which Gen. Dix gave in reference to the man who attempted to haul down the Stars and Stripes should be metaphorically meted out to those who seek to lower the high standard of merit and reliability which in capable hands it has already attained.

(*To be continued.*)

THE new mantel and fireplace for "The Breakers," Cornelius Vanderbilt's private residence, Newport, R. I., is of terra-cotta, seventeen feet high, and cost seventy-five thousand dollars. The material was taken from the ruins of an old Roman villa at Pompeii.

THE building material business formerly carried on by the firm of Pinkham & Company is assumed, and will be conducted by I. W. Pinkham Company, 17 Milk Street, Boston. The new company carry a fine line of brick, terra-cotta, roofing slate, and slate products.

Fireproofing Department.

Conducted in the Interests of Building Construction to Prevent Loss by Fire.

THE MODERN OFFICE BUILDING.

BY J. HOLLIS WELLS, C. E.

(Continued from April Number.)

ONE of the most recent examples of a model building is one designed for Mr. Joseph Fahys by Clinton & Russell, architects. This building is located in the jewellers' district, on an irregular-shaped piece of property, is twelve stories in height, and constructed on the most approved principle. The sub-foundation is a wet, running mixture of sandy loam and mica, very compact when properly confined, but treacherous when carelessly prepared. Over the entire plot is spread a solid foundation of concrete and steel beams, a total of three feet in thickness, distributing the weights with an average pressure on the subsoil of about three tons per square foot. The columns are built of steel I beams, channels, and plates, and start from footings of compound riveted girders four feet high and extending the full length of the building on both sides. All beams and girders are of steel, and the entire construction is designed for a dead load of sixty pounds per square foot and a live load of one hundred and forty pounds per square foot. The columns, in addition to carrying these loads, are designed to carry the resultant strains of a wind pressure against the sides of the building of twenty-five pounds per square foot. Wind bracing consists of triangular pieces built of plates and angles and are riveted to the columns, and the girders are riveted in turn to the bracing, so that the entire structure is absolutely rigid. Fig. 2, Plate 37, shows the general detail of the column and girder connections. This building is undoubtedly one of the strongest in the city. There has been no appreciable settlement or sway, and although one front is twenty-five feet wide and one hundred and sixty feet high, the effect of a high wind has as yet been absolutely unnoticed. All the structural steel work was painted two heavy coats of Eureka paint before the brickwork was commenced. Construction was commenced late in December, and ten weeks later the roof ties of beams was completely set, making a total of about one thousand tons of material furnished, set, and every connection riveted up complete in less than three severe winter months.

The fronts on both streets are an adaptation of the style of Francis I. The two lower stories are of granite and Indiana limestone. The limestone is richly and handsomely carved, and is topped over the second story with an elaborately detailed balustrade. The upper story walls are faced with a light buff brick costing thirty dollars a thousand, and the entire front is topped out for one story in height with terra-cotta and surmounted with a richly designed railing cast in the same material. Fig. 3, Plate 37, shows the detail of the terra-cotta cornice and rail, which is of a light rich tint to match the brickwork, and is a most excellent sample of the best class of work made in this vicinity.

Fig. 1, Plate 37, shows the plan or lay-out of this building, and serves in general to describe the usual design for nearly all the better class of buildings, and the building has been constructed throughout on the lines already laid down. The very best of workmanship has been insisted on, and the most satisfactory of results have been obtained. All offices are light and airy, and the electric elevator service is regular. This building is described because it is one of a large class of buildings similar in design, and built for the same general use. To describe one office building properly built is to describe them all.

The cellar of a modern office building is almost entirely given up to the power, heating and ventilating plant. There are usually at least two large high-pressure tubular boilers, two steam or electric pumps, one for feeding boilers and the other for house and fire service, two and oftentimes more dynamos with their engines, either additional dynamos or else pumps for furnishing power for the elevators; motors or else cylinders and tanks, as the elevators are electric or hydraulic, to lift them, a feed-water heater, a pump governor, a blow-off tank, hot water and storage tanks, electric service switchboards, and a network of power, heating and ventilating pipes with their regulating valves, etc. A system intricate enough in its lay-out to tax the resources of an expert engineer in order that it may be complete, economical, and at the same time absolutely efficient in all its parts.

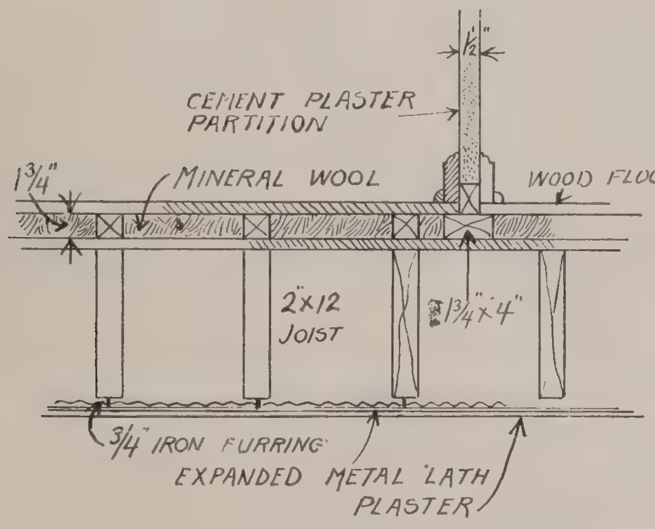
So many of these buildings have been built within the past few years that it is now an easy matter to figure out the cost of construction. A first-class office building, carefully planned and well specified, can be built for not less than from thirty-six to forty cents per cubic foot. This includes measurements taken from the cellar bottom to the highest point of the roof tier of beams, and on the outside of all walls. It also includes the cost of all partition work, gas and electric light fixtures complete. A building on a plot of ground 50′ x 100′ was built twelve stories high, or about 155′ from cellar floor to top of roof beams, and cost in the neighborhood of $250,000, or approximately 38½ cents per cubic foot. The property alone is valued at $300,000, making a total valuation of $550,000 for building and property. It costs to run this building, exclusive of taxes and larger repairs, and including wages of a janitor, an engineer, a fireman, four elevator men, scrub-women, fuel, supplies, etc., $12,500 per annum. A building of this class rents at from $1.75 to $2.50 per square foot of floor surface. The above building contained 36,000 square feet at an average rental of $2.00 per square foot, a total rental of $72,000 per annum. The modern office building is undoubtedly therefore a paying investment if properly managed. As to whether the thing is being overdone, and too many buildings are being erected, will be decided in time, but there is no doubt that there is still plenty of demand for improved office space, and that the old-time structures must be replaced by the structure of the present decade. The one great mistake of the age is that in the spirit of rivalry that exists as to who shall have the most attractive building, the question of general health and of real architectural effect is overlooked. The narrow streets of the metropolis are being lined on both sides with enormously high piles of brick, stone, and steel, and the sidewalks, far below the tops of the buildings, are usually damp, and the air is laden with malaria, for no sunlight ever reaches to the curb, and the low-lying strata of air is heavy and oppressive. A building over 170 feet in height is a monument of engineering skill and cannot be made an architectural success. No combination of brick, stone, and terra-cotta can relieve the structure of its bare, straight lines and its top-heavy effect. The building of the American Surety Company, twenty stories in height, an immense piece of work, excites admiration simply on account of its effect as a high building; the building of the Mutual Life Insurance Company, on the contrary, is one of the best examples of a moderately high building, and from an architectural standpoint is a most beautiful design. It is only a question of time, therefore, when this fad will play out, and buildings of a normal size will be built. This matter is even now being agitated by the authorities, and will be made a subject for legislation; in fact there are, at this time, current rumors to the effect that a bill has been drafted for presentation to the Legislature which will regulate the extreme height of any future building that may be erected in the city of New York.

THE Staten Island Terra-Cotta Lumber Company wish to announce to their patrons that the embarrassment that the company has lately been under has been removed, and they are now in a better condition to fill orders and conduct a large business than ever before. The financial resources of the company have been strengthened by a large addition of money paid in.

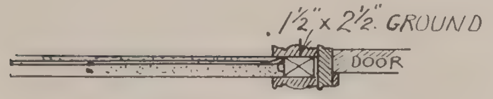
SOLID PARTITIONS.

ONE of the new apartment buildings just completed in Chicago is the "Dubuque," Treat & Foltz, architects. The structure is one hundred feet square, eight stories high, and contains forty-seven suites of apartments, beside a drug store, a physician's and a dentist's office, and baths, laundries, and servants' sleeping-rooms in basement.

One item of interest is the solid one and one half inch partitions used throughout the eight stories, which vary in height from nine to thirteen feet. The saving in space by the use of the one and one half inch partitions as compared with a four-inch tile partition is nearly three feet in the thickness of eight partitions, or a saving of floor area in each story of the Dubuque Building of five hundred square feet, equivalent to a room over twenty feet square. The partitions in this building are made of a cement plaster (lime mortar will not answer the purpose) on expanded metal lath, the latter being first wired to five-eighths inch channel iron studs, sixteen inches apart.



SECTION OF FLOORS:-"DUBUQUE" BLDG.



PLAN SECTION OF DOOR TRIM.

(See accompanying sketch, showing construction.) Though seemingly very flimsy during erection, the partitions are, after the plaster is set, stiff and strong enough for ordinary residence or office purposes, and seem stable enough to stand continued slamming of doors better than tile partitions. In fact, such partitions have stood the test of four years' use in one office building. The greatest difficulty is to hold these thin partitions straight and true till the plaster is set. The dampness in a last finish putty coat is sufficient to warp the partitions like cardboard. This, of course, makes crooked and vexatious work with the wood finish. Another drawback is the time required to dry thoroughly one and one half inches of solid plaster, and the consequent danger of getting trim and kalsomine on too soon in rush work.

FIRE LOSSES. — London has only forty fires a week, and most of these are insignificant. If the great city were constructed on the American plan, its fire losses would be twenty million dollars a year instead of a fraction of that sum. — *Globe-Democrat*.

EXHIBITION BY THE ELECTRIC FIREPROOFING COMPANY. — DEDUCTIONS.

BY F. E. CABOT.

THE exhibition given in Boston by the Electric Fireproofing Company on Saturday, May 3, is especially interesting as an evidence of the growing tendency among those who are connected with the construction of buildings to use every means afforded, science or art, in producing material which is at the same time of low cost, and in some measure at least fire resisting. The claim of this particular company is, as we understand it, that wood which has been treated by their process becomes, to a large degree, non-inflammable, using this word in its true sense, *i. e*, not developing flame. No claim is made, as the writer understands it, that wood, when treated by their process, will not carbonize or become charcoal when subjected to high temperatures, but the claim is made, and the writer believes fairly made, that any wood can be so treated by their process that it will not, under any circumstances, produce flame, and that whenever the surface of wood so treated has been carbonized by flame against it, no additional fire will come from the wood itself. In other words, as soon as the fire is removed the charcoal will at once, without assistance, extinguish itself, and that moreover the layer of charcoal thus formed will be a great protection to the wood not directly in contact with the flame.

The exhibition referred to above was made in and around a small structure, built enirely of wood which has been through this company's process, and it required a careful examination to determine that it was not made of ordinary lumber. The building was approximately twelve feet six inches square, and eight feet to the eaves, with a hipped roof, terminating in a wooden chimney two feet square, and about eight to ten feet high, over which was a wooden cap, carried on four posts two feet above the top of the chimney. The entire structure was raised about two feet from the ground on wooden posts, and had openings in three sides, two windows and a door, the windows being opposite to each other, and the door in one of the intervening sides. The fourth side was without a break, and on this side there was no interior finish, the studding being entirely unprotected, except by a coating of white paint, made, as the writer understands, of a material very similar to that with which all the woodwork had been treated before it was put together. The outside boarding was covered with two layers of sheathing paper and clapboards of ordinary form, and the roof was shingled. The lumber was of such dimensions as would be used in the construction of an ordinary dwelling, and the whole building was made attractive by a coat of paint. The inside walls in which there were openings were sheathed for about three feet from the floor with a moulded trim, and the space above was lathed as if ready for the plaster. The sheathing, which was of various kinds of wood, was planed smooth, but none of the woodwork on these sides was painted or finished in any other way. The whole structure was raised about two feet from the ground on posts at each corner, and the space under the floor was entirely open and unprotected.

The first part of the test was to demonstrate the resistance of the building to a fire from the outside, and for this purpose a fire of shavings and split pine logs was built on the ground directly under the shuttered window. This was maintained for half an hour, and from the inside of the building no effect was apparent except from the smoke which worked through the joints of the floor boards. At the end of this time a fire was built under the unprotected window and another inside the house, directly on the floor, and the first fire was supplied with fresh fuel so that three fires were playing directly on the building. These fires were maintained for half an hour more, and then a gallon of kerosene oil was thrown on the fire inside the building. The effect was very striking, as a mass of flame poured out of the wooden chimney, and the heat became so intense that the panes of glass in the window melted down into a solid mass, now in the possession of the writer. This lasted for six minutes, after which the fires were allowed to die down to coals, which were extinguished by a few minutes' use of a garden hose. The only apparent effect on the building was the destruction of the lathing and the bars of the window frames, and a hole about three feet square in the floor, just over the first fire, which, it should be remembered, had been burning over an hour. All the wood on inside of the building was charred to a depth varying from a quarter to three quarters of an inch, but the building from the outside looked almost intact, and the floor, except at the edges of the hole, was strong enough to bear the weight of two men.

It may be fairly said, therefore, that the claims of the company's representative, Mr. Max Bachert, seem to have been sustained, but in all fairness it must be said that, even assuming that these claims are fully proven, there still remains some doubt as to the final value of the process. With all due respect to the company, it is, without doubt, true that similar processes for the preservation of wood from *decay* have been thoroughly tried at least twenty years ago, and further, that at least one of the chemicals used in these processes has a very considerable value in resisting the tendency of wood to burst into flame. Yet to-day we hear little of these processes, although they have had ample opportunity to prove their value. Furthermore, so far as the writer could learn, the company is not as yet prepared to give any figures as to the probable additional cost of lumber treated by their process, and it is, therefore, impossible to judge of the comparative cost of wood thus treated, and material truly fire resisting like brick and other fire-made clay products.

The tendency to-day is to go further than the ground covered by this company's patents, and to call for material which will resist heat for some time without any deterioration, and which can be depended on in case of conflagration to stand as a barrier in the path of the flames. Such a barrier, wood can never be, even though treated so as not to add fuel to the flame. Brick and similar *fire-made* materials alone can be depended on for this work, and in combination with steel and iron, which *they* can thoroughly protect, must form the building material of the future. If, in a building of such construction, it may be thought best to use wood rendered non-inflammable, it will add to the safety of the interior, and where fireproof construction is not used the use of such wood will add something to the protection which is now sought everywhere, but this is all that can be expected from it, and no careful observer will believe that in any sense it can take the place of fireproof material.

A FRENCH SUBSTITUTE FOR FIRE BRICK.

A CORRESPONDENT of the London *Colliery Guardian* says: "On account of the difficulty of obtaining fire bricks of uniform quality, except from Great Britain, M. Bebois-Reuleaux has devoted considerable attention to finding a substitute at lower cost. After many experiments he has succeeded in obtaining an infusible product containing from ninety-five per cent to ninety-eight per cent of pure silica, which, mixed with another product, is said to insure perfect homogeneity, and at the same time absolute infusibility. The raw materials, which are found abundantly in several of the French departments, are so cheap that the bricks may be produced at half the cost of English for an equal quality. Some of these bricks tried in a blast furnace, at the hottest place, are reported by the manager to have stood thoroughly; and in the bridge of a puddling furnace, where only English bricks can withstand the heat, the new bricks were found quite satisfactory, as also in the bridge of a heating furnace worked for thirteen hours continuously. At some steel works, moreover, a half brick of the new manufacture was exposed during a whole day in a Siemens-Martin furnace, and was taken out without having undergone any change, and with the corners still sharp."

IN the June number the series of articles on Fireproof Floor Arches, by George Hill, C. E., will be resumed. Mr. Hill has recently completed a series of tests of arches which were constructed by a prominent fireproofing concern, and the results of these tests will be given.

Mortars and Concrete Department.

Devoted to Advanced Methods of using Cements and Limes in Building Construction.

AMERICAN CEMENT.

BY URIAH CUMMINGS.

IV. — *Continued.*

TABLE OF ANALYSES. Hydraulic Limes and Cements.

Number	Silica	Alumina	Iron oxide	Lime	Magnesia	Potash and Soda	Sulphate of lime	Carbonic-acid water and loss
1	16.05	1.92	3.22	77.29	1.52	....	....	....
2	24.33	3.73	....	71.94	....	....	....	....
3	29.71	5.35	3.29	59.53	0.95	1.17	....	....
4	20.57	1.13	....	77.76	0.54	....	....	....
5	28.14	9.10	3.20	53.34	1.00	2.80	....	2.42
6	27.88	6.19	4.64	56.45	4.84	....	....	....
7	25.31	7.03	9.74	56.17	1.75	....	....	....
8	44.50	15.00	12.00	8.80	4.70	5.50	....	9.50
9	48.94	18.75	11.92	6.40	2.42	3.93	....	7.64
10	19.75	7.48	5.01	60.71	1.28	0.75	1.64	3.38
11	24.90	8.00	3.22	59.38	0.38	0.50	1.46	2.16
12	20.42	12.00	1.87	63.13	0.58	....	....	2.00
13	23.36	8.07	4.83	58.93	1.00	0.50	0.85	2.46
14	22.74	7.74	3.70	56.68	0.57	0.63	1.66	6.28
15	21.11	11.30	3.36	58.03	2.93	0.71	0.51	2.05
16	24.30	2.61	6.20	39.45	6.16	5.30	....	15.23
17	34.66	5.10	1.00	30.24	18.00	6.16	....	4.84
18	23.16	6.33	1.71	36.08	20.38	5.27	....	7.07
19	26.40	6.28	1.00	45.22	9.00	4.24	....	7.86
20	25.28	7.85	1.43	44.65	9.50	4.25	....	7.04
21	30.50	6.84	2.42	34 38	18.00	3.98	....	3.78
22	29.98	6.88	2.50	33.23	17.18	7.10	....	3.13
23	30.84	7.75	2.11	34.49	17.77	4.00	....	3.04
24	27.30	7.14	1.80	35.98	18.00	6.80	....	2.98
25	27.98	7.28	1.70	37.59	15.00	7.96	....	2.49
26	28.38	11.71	2.29	43.97	2.21	9.00	....	2.44
27	19.90	5.92	1.14	46.75	16.00	8.02	....	2.27
28	22.62	7.44	1.40	40.68	22.00	2.23	....	3.63
29	27.69	8.64	2.00	42.12	14.55	2.00	....	3.00
30	24.34	8.56	2.08	61.62	0.40	2.00	....	0.80
31	22.91	8.00	1.90	61.76	2.70	....	....	2.63
32	23.32	6.99	5.97	53.96	7.76	....	....	2.00
33	22.10	15.00	3.21	55.98	0.37	....	3.34	....
34	24.94	9.00	1.16	63.64	1.26	....	....	....
35	27.60	10.60	0.80	33.04	7.26	7.42	....	2.00
36	33.42	10.04	6.00	32.79	9.59	0.50	....	7.66
37	22.58	7.23	3.35	48.18	15.00	....	....	3.66
38	22.44	6.70	2.00	32.73	0.67	....	....	35.46
39	26.61	10.64	3.50	42.12	13.12	2.00	....	2.01
40	17.50	6.50	3.00	36.51	....	....	....	36.49
41	22.21	16.48	1.67	39.64	17.50	....	....	2.50
42	32.06	21.27	2.11	35.56	7.00	....	....	2.00
43	28.45	2.24	2.00	56.00	10.00	....	....	1.31
44	18.59	9.14	1.00	40.70	27.00	....	....	3.57
45	19.52	1.97	1.29	41.51	1.47	....	....	34.24
46	28.02	10.20	8.80	44.48	1.00	0.50	....	7.00
47	19.35	7.00	4.50	63.75	....	....	....	5.40
48	21.14	6.30	2.50	66.04	1.11	....	....	2.91
49	22.69	7.30	2.87	62.28	1.08	....	....	3.78
50	20.80	7.39	2.61	64.00	....	....	....	5.20
51	23.20	7.03	2.41	64.19	0.97	....	....	2.20
52	22.89	8.00	2.44	63.38	2.30	....	....	0.99
53	25.15	8.00	3.28	49.53	13.78	....	....	0.26

REFERENCE.

No. 1. Hydraulic Lime, Aberthaw, England, used in the construction of the Eddystone Lighthouse.
" 2. Hydraulic Lime, Lyme Regis, England, used in the construction of the London docks.
" 3. Eminently Hydraulic Lime, Holywell, Wales, used in the construction of the Liverpool docks.
" 4. Hydraulic Lime, Teil, France.
" 5. Hydraulic Cement, "King's Farm," on Susquehanna River, near Williamsport, Penn.
" 6. Roman Cement, Rudersdorf, Germany.
" 7. Roman Cement, Isle of Sheppy, England.

No. 8.	Pozzuolana, near Rome, Italy.			
“ 9.	Trass, from the valley of the Rhine.			
“ 10.	English	Portland	Cement,	“K., B. & S.” brand.
“ 11.	German	“	“	Alsen & Son.
“ 12.	Natural	“	“	Boulogne, France.
“ 13.	American	“	“	“Giant,” Egypt, Penn.
“ 14.	English	“	“	given by Reid as first quality.
“ 15.	German	“	“	“ “ “ “ “ “
“ 16.	Buffalo	Hydraulic	“	Buffalo, N. Y.
“ 17.	Utica	“	“	Utica, Ill.
“ 18.	Milwaukee	“	“	Milwaukee, Wis.
“ 19.	Louisville	“	“	“Fern Leaf,” Louisville, Ky.
“ 20.	Louisville	“	“	“Hulme,” Louisville, Ky.
“ 21.	Rosendale	“	“	“N. L. & C. Company, Rosendale, N. Y.
“ 22.	“	“	“	“Rock Lock,” Rosendale, N.Y.
“ 23.	“	“	“	“N. Y. & R.” Rosendale, N. Y.
“ 24.	“	“	“	“Hoffman,” Rosendale, N. Y.
“ 25.	“	“	“	“Norton High Falls,” Rosendale, N. Y.
“ 26.	Cumberland	“	“	Cumberland, Md.
“ 27.	Napanee	“	“	Napanee, Ont.
“ 28.	Akron	“	“	“Newman,” Akron, N. Y.
“ 29.	“	“	“	“Cummings,” Akron, N. Y.
“ 30.	California	“	“	South Riverside, Cal.
“ 31.	American	Portland	“	“Saylor's,” Coplay, Penn.
“ 32.	Fort Scott	Hydraulic	“	“Brockett,” Kansas City, Mo.
“ 33.	Gate of France	Hydraulic	Cement,	France.
“ 34.	Vassy	Hydraulic	Cement,	France.
“ 35.	Utica	“	“	La Salle, Ill.
“ 36.	Shephersdstown	Hydraulic	Cement,	Shepherdstown, Va.
“ 37.	Howard	Hydraulic	Cement,	Cement, Ga.
“ 38.	Hydraulic Cement Rock on Platte River, Nebraska.			
“ 39.	Mankato	Hydraulic	Cement,	Mankato, Minn.
“ 40.	Hydraulic Cement Rock, near Salt Lake City, Utah.			
“ 41.	St. Louis	Hydraulic	Cement,	near East Carondelet, Ill.
“ 42.	Barnesville	Hydraulic	Cement,	Barnesville, O.
“ 43.	Warnock	“	“	Warnock, O.
“ 44.	Austin	“	“	Austin, Minn.
“ 45.	Hydraulic Cement Rock, Blacksburg, S. C.			
“ 46.	Round Top	Hydraulic	Cement,	Hancock, Md.
“ 47.	German	Portland	Cement,	“Dyckerhoff” brand.
“ 48.	“	“	“	“Germania” brand.
“ 49.	“	“	“	“Porta” brand.
“ 50.	American	“	“	“Empire,” Warners, N. Y.
“ 51.	“	“	“	“Medusa,” Sandusky, O.
“ 52.	“	“	“	“Alpha,” Phillipsburg, N. J.
“ 53.	James River	Hydraulic	Cement,	Balcony Falls, Va.

This table of analyses has been compiled with the utmost care, no labor having been spared to make it as perfect as possible.

Among the authorities consulted and relied upon are Beckwith, Bennett, Bode, Boynton, Cox, Davidson, DeSmedt, Dodge, Dorr, Miller, Newberry, Ogden, Reid, and Winchell, analysts and chemists of established reputation.

In many cases a selection has been made from several analyses of the same brand of cement, and in this, as in all other respects, great care has been exercised with a view to formulating a table which may be confidently relied upon.

(*To be continued.*)

The Howard Hydraulic Cement Company, Cement, Ga., will rebuild its cement mill, and is in the market for machinery for same.

A company has been formed in Dayton, O., for the purpose of manufacturing Portland cement.

Philadelphia, Pa., May 14, 1895.

Editor of The Brickbuilder:

Sir, — I note in the April issue of your magazine that Mr. Leonardt takes some exceptions to my remarks on American Portland cement, and his views coincide with the former remarks made by Mr. R. Tucker, to wit: “The Portland cement of American manufacture has a long road to travel before reaching the standard of excellence achieved by its rivals across the water.” Now I maintain that the American Portland cements, as a class, have attained that degree of excellence possessed by the cements (as a class) that are made across the water. (See tests published in The Brickbuilder of November, 1894.) All impartial and thorough tests made on the general run of foreign Portlands in comparison with the American Portlands, on sale in this part of the country, prove this to be a fact.

Now if Mr. Leonardt or Mr. Tucker have any thorough tests made with the leading American Portlands in comparison with the foreign Portlands, which show the latter to be so very much superior to the former, send them to The Brickbuilder and let the readers see them. If they have not got any such data to back up their opinions, they have done the American manufacturers, who are now making cement equal to the best and superior to many of the foreign brands which now have a large sale in this country, a great injustice by publishing such statements.

In addition to the tests published in The Brickbuilder of November, 1894, any interested reader can get from the Water Commission of St. Louis their last report, which gives the results of tests on all the cement used in the construction of the new water supply for St. Louis. The tests were made of one part cement to three parts sand, which is the test recommended by the German Association of Cement Manufacturers, and are carried out from one week to two years. This report shows that a brand of American Portland cement showed a strength of ten to twenty per cent greater than two of the German brands (Alsen and Dyckerhoff) Mr. Leonardt mentions.

In reference to Mr. Leonardt's statement that the “Saylors Portland Cement Works,” owned by the Coplay Cement Company, although the largest in this country, are not to be compared with the Dyckerhoff, Alsen, Germania, Mannheimer, or Heidelberg works, and that if I would visit those factories I would find a superior plant than those at Coplay, would say that before I made the statement last October in The Brickbuilder I was thoroughly acquainted with the Coplay plant as well as the leading European works. In the summer of 1892 the Coplay Cement Company decided to greatly increase their plant, the demand for their Portland cement being greater than the output, which was one hundred and fifty thousand barrels per annum. Having been identified with the sale of American Portland and being interested in and acquainted with the manufacture of cement, I was invited to spend the winter of 1892 and 1893 in Europe with Mr. Chas. M. Saeger, superintendent of the Coplay Cement Company, to investigate the different processes of making cement and the working of the different kilns. Among the works visited in Germany were the Alsen, Germania, and Dyckerhoff plants. The Germania Works at Lehrte, having just been entirely rebuilt on account of destruction by fire, were about the newest type of a German mill. In no factory visited by us did we find more complete laboratories than those at Coplay. The mills were just as dusty and some of them more so; but whether this dust is drawn out of the mills by exhaust fans (as it is at Coplay) or not has nothing to do with the quality of the product manufactured, but is done mainly on account of the health and convenience of the employees.

We did not see a factory in Europe where more conscientious care was taken to select the clinker than at Coplay, Pa., and in no factory did we find so little under-burnt material as at home, which we attribute to the fact that the cheapness of fuel in this country leaves no inducement for the manufacturer to skimp his fuel and run the risk of getting a large percentage of poorly burnt cement. Although in most German factories this under-burnt material was being picked out, no attention was paid to it in the English factories visited by us, and all the contents of the kilns found their way to the grinding mills.

The new kilns at the Saylors American Portland Cement Works are of a newer type of continuous kiln than those used in the German factories, and are very much more economical in fuel. As to the new German mills being better constructed than the American mills, would say that the new works of the Coplay Cement Company are built of brick, concrete, and steel, and in arrangement, light, ventilation, etc., are far superior to any factory Mr. Leonardt mentions, or that was in existence in Germany in the winter of 1892 and 1893. It is most likely that Mr. Leonardt has not seen the works at Coplay for some years, and I would suggest that he, or any one else who has seen the large works in Germany, take a trip to the Saylors Portland Cement Works at Coplay, Pa., before attempting to draw comparisons, and if the party is acquainted with the manufacture of cement, the comparison cannot help being in favor of the American mills.

The encourgement and preference now being given by our leading engineers to the American Portland cements bid fair to largely increase its manufacture, so that at no distant day the Portland cement consumed in the United States will all be made at home. This, I believe, is the honest wish of every American.

WM. G. HARTRANFT.

MR. MICHELE'S test for Portland cement for 1895 is as follows: Pats ⅛ inch thick in water, absolutely sound at seven days; tensile strength, 400 pounds per square inch at seven days; fineness, five per cent. residue on a 50 sieve. The pats to be gauged on glass, immersed in water immediately and left there for the whole period. One pat to each three bricks. The test bricks to be gauged by a skilled man, with a minimum quantity of water, and well rammed into moulds. The average of three to be taken, which shall represent about 100 tons or less. The strain to be applied as quickly as possible. The sieve to have 2,500 holes per square inch, and to be of wire not less than .007 of an inch — 34 B. W. G. — in diameter. Shaking to be continued for five minutes.

TO THE EDITOR OF THE BRICKBUILDER:

Dear Sir, — I have been surprised to read in an American journal the remarks of Mr. F. Tucker and Mr. C. Leonardt derogatory of the character of American Portland cement. Having been connected with the sale and the manufacture of American Portland cement since it was first made in this country, and having probably as large a familiarity with its use as any one, I want to contradict most emphatically the statement of Mr. Leonardt that American Portland cements "lack continued uniformity and tensile strength," and that "for a time they will be equal to the best imported, and all at once the same factory will bring an article into the market with hardly any tensile strength, far below the average, or which sets too fast or not at all."

I have neither time nor desire to waste words upon either Mr. Tucker or Mr. Leonardt, but I send you herewith a record of nearly three hundred thousand barrels of Giant Portland cement, which have been used on the most important works that have been done on the American continent within the past ten years, which records, covering a period of nearly eight years on practical work and laboratory tests, show conclusively the absolute incorrectness of the statements of Mr. Leonardt. When either of the gentlemen mentioned can produce a record on imported cement, similar to that which I append hereto, containing results on five separate and distinct works, upon samples in the laboratory and in the mortar boxes, made by innumerable testers and mortar mixers, and can show an absolute, uniform growth and continuity, such as these tests do show, *then* I think it will be time for the American manufacturers to be called to the defence of American Portland cement, which the tables here presented conclusively show to be not only as good, but better than the imported article.

Yours truly,

R. W. LESLEY,

Treasurer.

Long-Time Tests.

Tests of over Three Hundred Thousand Barrels "Giant" Portland, on five of the largest dams in the United States; on the Niagara Falls Power-Tunnel, and the Reading Terminal Railroad and Station, in Philadelphia, for periods up to five years.

The only records of long-time tests on Portland Cement now published in the United States.

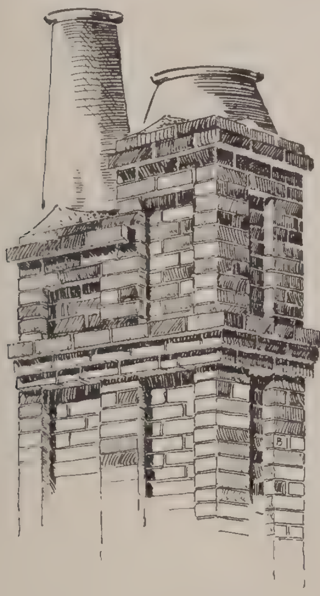
BRAND "Giant" Portland	MODE OF MIXING.	1 Day		1 Week		1 Mo.		3 Mos.		6 Mos.		9 Mos.		1 Year		15 Mos.		18 Mos.		2 Years		3 Years		4 Years		5 Years		FINENESS.		
		Number of Briquettes.	Average, in pounds.	Number of Briquettes.	Average, in pounds.	Number of Briquettes.	Average, in pounds.	Number of Briquettes.	Average, in pounds.	Number of Briquettes.	Average, in pounds.	Number of Briquettes.	Average, in pounds.	Number of Briquettes.	Average, in pounds.	Number of Briquettes.	Average, in pounds.	Number of Briquettes.	Average, in pounds.	Number of Briquettes.	Average, in pounds.	Number of Briquettes.	Average, in pounds.	Number of Briquettes.	Average, in pounds.	Number of Briquettes.	Average, in pounds.	Residue on No. 50 sieve, 2,500 holes to sq. in.	Residue on No. 74 sieve, 5,180 holes to sq. in.	Residue on No. 100 sieve, 10,000 holes to sq. in.
Sodom and Bog Brook Dams, New York Aqueduct. About 50,000 bbls.	Neat	1,025	**140**	1,398	**348**	220	**422**	180	**540**	100	**634**	30	**638**	180	**682**	30	**687**	110	**672**	110	**694**	90	**736**	60	**771**	10	**840**	......	......	**18.0**
	2 to 1	. .	...	220	**166**	120	**280**	140	**364**	84	**468**	50	**468**	90	**490**	36	**526**	100	**530**	100	**564**	130	**680**	120	**674**	20	**700**			
	3 to 1	....	...	226	**140**	140	**234**	112	**350**	110	**428**	30	**428**	240	**420**	40	**500**	80	**514**	80	**512**	160	**572**	...	...	10	**590**			
Titicus Dam, New York Aqueduct. About 100,000 bbls.	Neat	3,448	**157**	4,165	**380**	637	**476**	505	**529**	478	**575**	479	**599**	350	**642**	181	**594**	135	**584**	137	**641**	62	**668**	...	...	...	...	......	......	**11.7**
	2 to 1	....	...	2,934	**200**	424	**317**	281	**450**	321	**491**	278	**532**	219	**549**	157	**557**	92	**541**	52	**536**	37	**573**							
	3 to 1	....	...	1,604	**115**	260	**185**	450	**289**	133	**347**	146	**311**	132	**426**	70	**424**	66	**416**	126	**419**	7	**483**							
Carmel and Craft's Dams, New York Aqueduct. About 40,000 bbls.	Neat	1,786	**140**	1,075	**343**	324	**443**	551	**517**	529	**548**	491	**568**	289	**617**	...	...	273	**604**	211	**611**	...	...	...	...	...	...	......	......	**14.7**
	2 to 1	....	...	1,642	**182**	216	**308**	85	**445**	87	**480**	76	**472**	43	**585**	...	...	49	**477**	55	**475**									
	2 to 1 from Mortar Box	....	...	61	**164**	51	**237**	8	**385**	11	**494**	8	**491**	7	**367**	...	...	12	**516**	3	**568**									
	3 to 1	....	...	13	**100**	13	**174**	7	**319**	12	**372**	11	**398**	10	**413**	...	...	8	**401**	10	**406**									
	3 to 1 from Mortar Box	....	...	45	**112**	31	**166**	6	**310**	8	**480**	7	**500**	9	**541**	...	...	7	**437**	5	**406**									
Reading Terminal Railroad and Station, Philadelphia. About 60,000 bbls.	Neat	....	...	329	**315**	267	**376**	69	**451**	15	**549**	16	**576**	10	**523**	1	**640**	...	...	...	...	...	...	...	...	...	...	**.090**	**10 04**	**14.79**
	3 to 1	....	...	536	**79**	431	**129**	104	**174**	20	**228**	15	**225**	47	**261**	5	**287**													
	2 to 1 from Mortar Box	....	...	190	**84**	180	**144**	17	**219**	13	**234**	25	**281**	62	**325**	12	**417**													
Niagara Falls Tunnel, Niagara Power Co. 60,000 bbls.	Neat	....	...	495	**321**	309	**420**	12	**514**	24	**562**	...	...	24	**661**	...	...	...	...	...	...	...	...	...	...	...	...	......	......	**14.9**
	2 to 1	....	...	482	**152**	271	**242**	54	**369**	20	**454**	...	...	7	**472**															
	3 to 1	....	...	527	**98**	399	**177**	143	**254**	181	**301**	...	...	12	**391**															

The Mason Contractors' Department.

Conducted in the Interests of the Builder and the Contractor for Brickwork.

WHY DO THEY CRACK?

PERHAPS there is no part of the building business in which the skill and judgment of the contractor are taxed more than the successful dealing with compressible soils in the erection of an edifice; in fact, the public look upon the operation with caution, and are not satisfied unless the work is intrusted to men of practical experience and reputed care and judgment in the successful performance of such undertakings.



In constructing a foundation the object is not so much to secure an absolutely unyielding base as to secure one that will settle as little as possible, and *uniformly*. All soils will yield somewhat under the pressure of any building, and even masonry itself is compressed by the weight of the load above it. The pressure per square foot should therefore be the same for all parts of the building, and particularly of the foundation, so that the settlement may be uniform. If the axis of pressure does not coincide exactly with the axis of the base, the ground will yield most on the side which is pressed most; and as the ground yields the base assumes an inclined position, and carries the lower part of the structure with it, thus producing unsightly cracks if nothing more. The coincidence of the axis of pressure with the axis of resistance is of *first* importance. This principle is self-evident, and yet the neglect to observe it is the most frequent cause of failure in the foundations of buildings. Fig. 1 is an example of how the principle is violated. The shaded portion represents a heavily loaded exterior wall, and the light portion a lightly loaded interior wall. The foundations of the two walls are rigidly connected together at their intersection. The centre of the load is under the shaded section, and the centre of the area is at some point farther to the left, consequently the exterior wall is caused to incline outward, producing cracks at or near the corner of the building. Doubtless the two foundations are connected in the belief that an increase in the bearing surface is of first importance. Fig. 2 is another illustration of the same principle. The foundation is continuous under the opening, and hence the centre of the foundation is to the left of the centre of pressure; consequently the wall inclines to the right, producing cracks, usually over the openings. The centre of the load can be made to fall inside of the centre of foundation by extending the footings outwards, or by curtailing the foundations on the inside. The latter finds exemplification in the properly constructed foundation of a wall containing a number of openings. For example, in Fig. 3, if the foundation is uniform under the entire front, the centre of pressure must be outside of the centre of the base, and consequently the two side walls will incline outward, and show cracks over the openings. If the width of the foundation under the openings be decreased, or if this part of the foundation be entirely omitted, the centre of pressure will fall inside of the centre of base, and the wall will tend to incline inward, and hence be staple. One conclusion to be drawn from the above example is that the foundation of a wall should never be connected with that of another wall, either much heavier or much lighter than itself. Both are equally objectionable. A second conclusion is that the axis of the load should strike a little *inside* of the centre of the area of the base to make sure that it will not be *outside*.

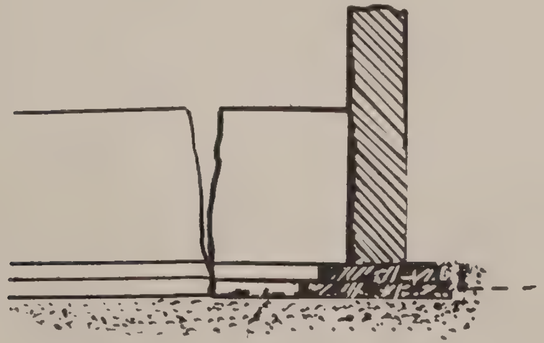


Fig. 1.

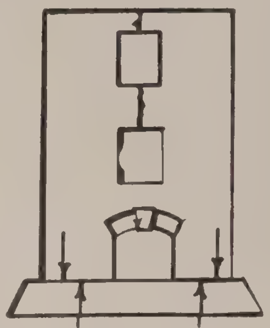


Fig. 2.

Any inward inclination of the wall is rendered impossible by the interior walls of the building, the floor beams, etc., while an outward inclination can be counteracted only by anchors and the bond of the masonry. A slight deviation of the axis of the load outward from the centre of the base has a marked effect, and is not easily withheld by anchors.

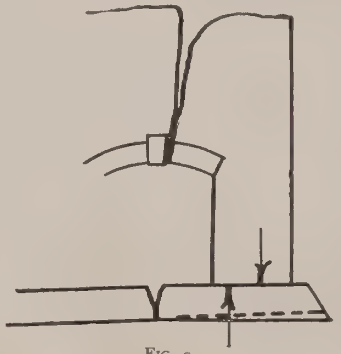


Fig. 3.

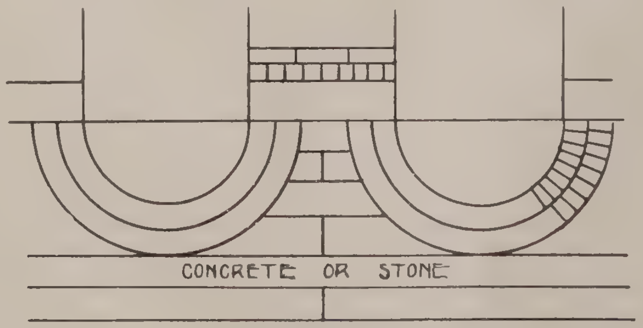


Fig. 4.

In places where the soil is loose and often even in good foundation, over which it is intended to place the apertures of the intended building, as to the doors, windows, etc., while the parts on which the piers are to be constructed are firm, the best plan is to turn an *inverted arch*, Fig. 4, under each of the intended apertures, as then the piers in sinking will carry with them the inverted arch, and by compressing the ground compel it to act against the under sides of the arch, which, if closely jointed, so far from yielding will, with the abutting piers, operate as one solid body. But, on the contrary, if this expedient of the inverted arch be not adopted, the part of the wall which is under the opening being of less height, and consequently of less weight than the piers, will give away to the resistance of the soil acting on its base, and not only injure the brickwork between the openings, but fracture the window heads and sills. In constructing so essential a part as the arch, great attention must be paid to its curvature; and where there is great weight depending, I strongly recommend the parabolic curve as the best adapted for this purpose; but if, in consequence of its depth, this cannot be conveniently introduced, the arch should never be less than a semicircle. The bed of the piers should be as uniform as possible; for though the bottom of the trench be very firm, it will, in some degree, yield to the great weight that is upon it; and if the soil be softer in one part than in another, that part which is the softest will, of course, yield more to the pressure and cause a fracture. If the solid parts of the trench happen to be under the intended openings and the softer parts where the piers are wanted, the reverse of the above practice must be resorted to; that is, the piers must be built on the firm parts and have an arch that is *not* inverted between them. In performing this, attention must be paid to ascertain whether the pier will cover the arch; for if the middle of the pier rest over the middle of the summit of the arch, the narrower the pier is the greater should be the curvature of the arch at its apex. Inverted arches are of great utility in giving stability to buildings, as they distribute the weight over the whole length of the foundation. When the radius of an inverted arch is small, that is to say, when it is under or not exceeding three or four feet, the best arrangement is to build two or more four-inch concentric rings as shown in figure, each of these rings being built as an independent arch laid in the strongest cement mortar. Never construct an inverted arch unless there is a strong abutment for them on both sides, as any settlement will tend to force the side wall out of perpendicular.

In conclusion, I will say that all foundations must be dealt with according to the attendant circumstances, and a knowledge of the method best adapted to any given conditions comes only by experience.

WILL. I. NOTT.

LEGAL POINTERS.

CONTRACTS SHOULD BE READ PERSONALLY. — A person who acts on the interpretation placed on a written instrument by a stranger, without having read it himself, cannot, in case the writing was capable of two interpretations, claim, as against its general meaning, that he in good faith acted on the other interpretation.

LACHES IN RELATION TO PARTY WALLS. — Equity will not compel the removal of an extension of a party wall on the grouud that it is a use not contemplated by the party-wall agreement, where the party complaining has made no objection until the extension is completed, but in such case he will be left to his remedy at law for damages.

EVIDENCE OF NEGLIGENCE. — The drawing apart of a splice in a wire rope provided by a company for hoisting, so that a workman is injured, is sufficient proof of negligence to make a *prima facie* case against the company, where there is testimony that well-made splices do not draw apart, and that the splices in such rope were not well made.

BREACH OF CONTRACT IN FURNISHING INFERIOR MATERIALS. — A building contractor is not excused for failure to furnish the quality of material contracted for by the fact that the work done was a fair average job for that class of building. And where a building contract calls for laths one and one fourth inches wide, and for number one rustic, and the best quality of joists and studding, and the contractor supplies laths one and one half inches wide, number two rustic, and a second quality of joists and studding, there is such a substantial breach of the contract as will warrant the owner in refusing to pay the contract price.

COMPENSATION FOR CONSTRUCTION OF PARTY WALLS. — An agreement between A and B that the former should erect a party wall on the line between their lots, and that the latter should have the right to use it at any time, on paying A one half the cost, is personal to both parties, and A is entitled to recover the amount agreed to be paid by B, though the party wall was first used by B's grantee, and although A had also conveyed his lot to the same grantee.

RETAINED PERCENTAGES NOT SUBJECT TO GARNISHMENT. — Where a construction contract provides for partial payments to the contractor as the work progresses, less ten per cent, to be retained by the owner to insure the faithful performance of the work according to contract, and for the payment of this percentage on the final completion of the work, the retained percentages are not subject to garnishment at the suit of the contractor's creditors, unless it appears that the contract was faithfully performed by the contractor, and that the balance of the work will be finished in like manner.

EDITOR THE BRICKBUILDER, BOSTON, MASS.

Dear Sir, — Replying to your correspondent, "A British Columbia Brickbuilder," in letter from Vancouver, B. C., under date of March 14, published in the April number of your valued magazine, in so far as it relates to the subject of liability and employees' accident insurance, the extensive experience of this office in placing insurance of this class in the various companies represented in the States leads us to believe that we have, perhaps, more liberal forms of contracts than are issued by the companies doing business in British Columbia.

Take, for example, the workmen's collective policy, or contribution policy, as it is termed by some of the companies. It is possible here to procure a contract covering one half wages for a term not exceeding fifty-two weeks, and all doctors' bills when the employee is disabled by accident either in or out of working hours, and in event of death by accident, under the provisions of this contract one half of a full year's wages, together with all doctors' bills and funeral expenses, are paid by the insurance company.

These contracts are issued in the name of the employer, are based on the estimated annual pay-roll, and are, as will be readily seen, much more liberal than the one mentioned by your correspondent.

It is customary to allow the employees to contribute a certain amount per week towards their own insurance, the amount varying according to the wages of the employees and consequent benefits derived.

This kind of insurance, of course, affords no relief to the employer when the injury is incurred in a manner which makes him legally liable, and for this reason most contractors hereabouts carry an employer's and public liability policy on forms covering absolutely all liability on account of injury to any person or persons whomsoever on or about the premises where the assured's operations are being conducted, or caused by any of the horses or vehicles owned or used by the assured in connection with his business.

These contracts are so broad that every feature of liability resulting from personal injury is fully covered, and accidents are of so frequent occurrence, and generally so expensive when they do come before the court, that no contractor or builder in this section feels like carrying the risk himself.

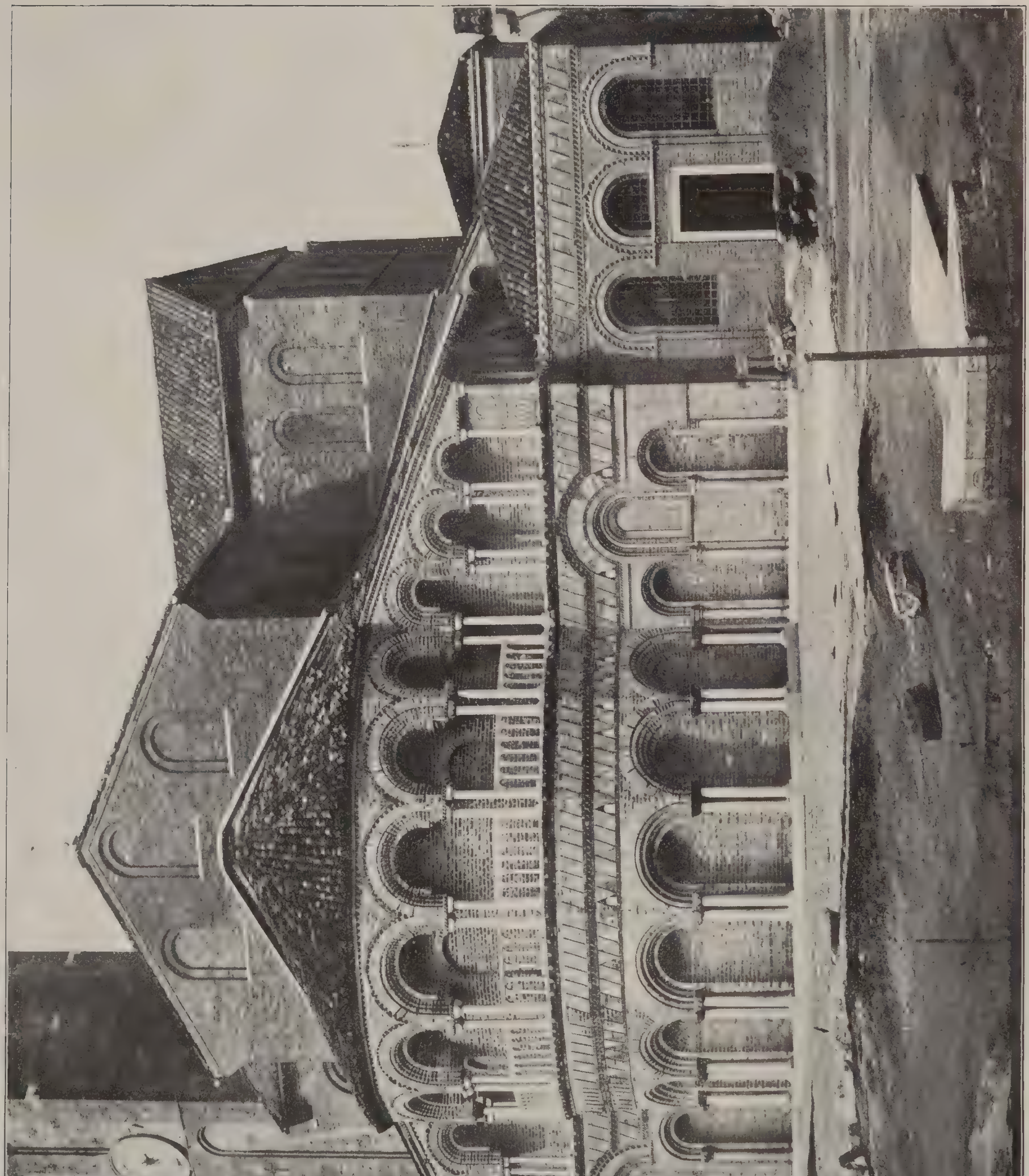
With eight companies in the field, bidding actively for the business, with a great variety of contracts and broad difference in rates, according to the views held by the various companies and based upon their own past experience with this particular hazard, as well as the additional and more important consideration, the financial standing of the company, — this latter especially, as most of our States allow six years from the date of accident in which to enter suit to recover damages, — the advice and knowledge of a broker as to all these points is of great value to the insurer, and results in his procuring a contract at a fair price in a reliable company which covers absolutely every feature of liability that can possibly arise on account of personal injury to employees or public resulting from his business operations. I am, dear sir,

Yours respectfully,

JOHN C. PAIGE.

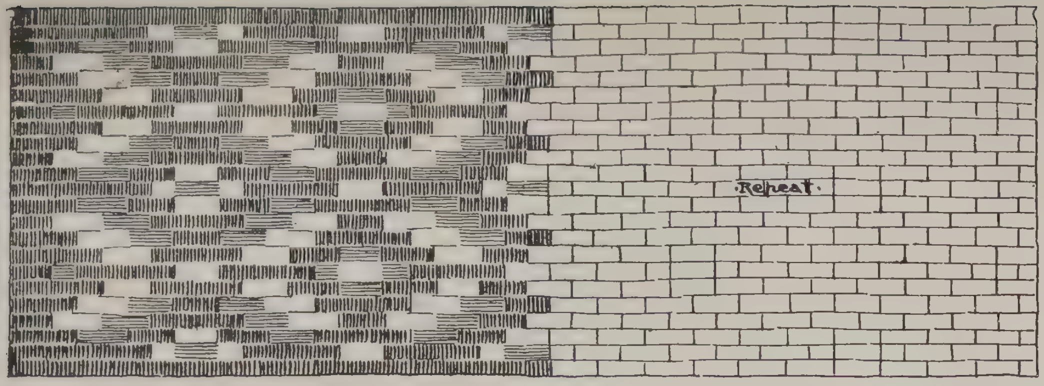
STRENGTH OF MORTAR.

THAT the common belief among builders that it is better practice to mix lime mortar and let it lay in a heap some days previous to use is well founded has been proven by recent experiments made in England. In the tests, samples of mortar were taken, on successive days, from two separate heaps of large size, briquettes were made therefrom, and, after an interval of some weeks, were broken for estimation of tensile strength. The brick fifty days old, which was made from mortar that had been in the heap three days, showed an average breaking weight of 34.6 pounds; while a brick forty-five days old, made from mortar which had been in the heap after mixing seven days, required 41.5 pounds' strain. — *Building Trades Journal.*

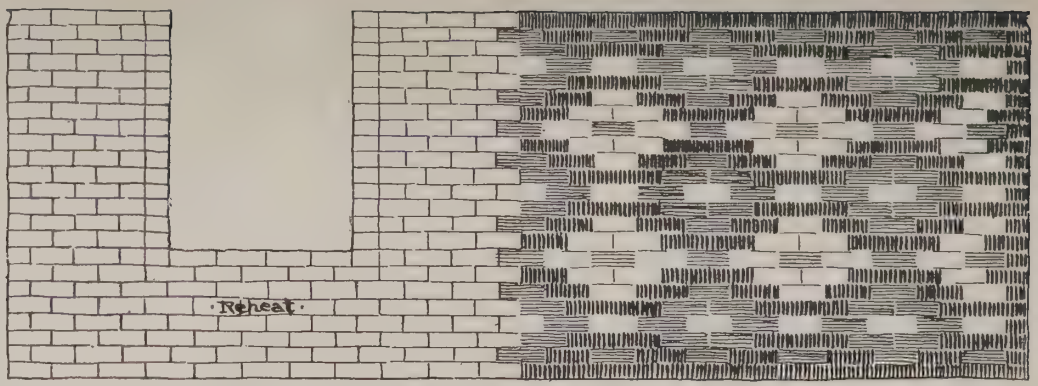


THE ASPE OF THE CHURCH OF SAN DONATO, AT MURANO.

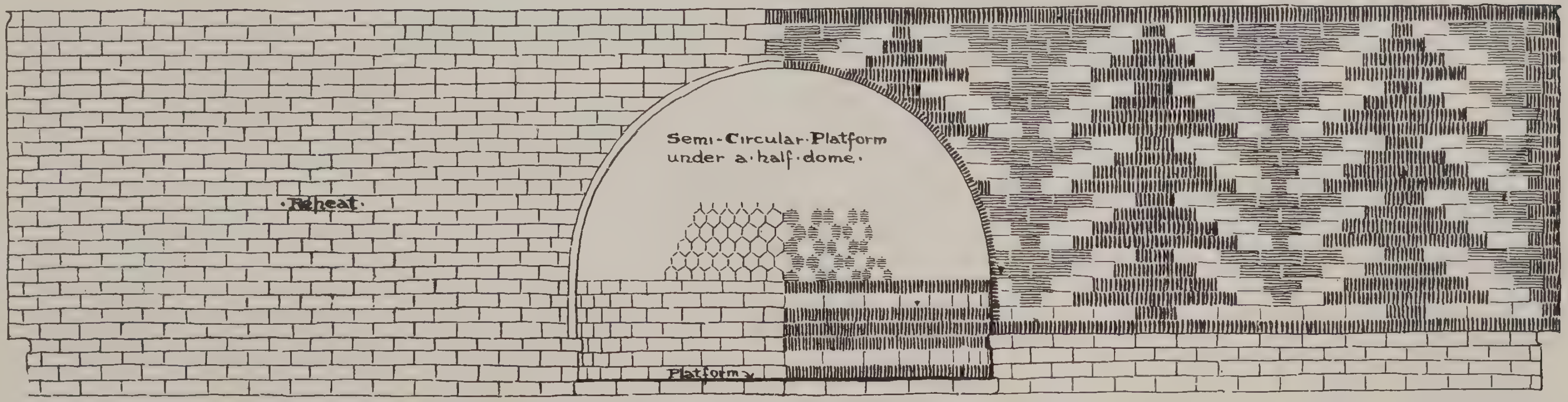
Supplementary Illustration to "Brick and Marble in the Middle Ages."



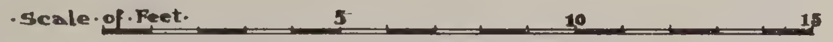
·West·Elevation·



·East·Elevation·

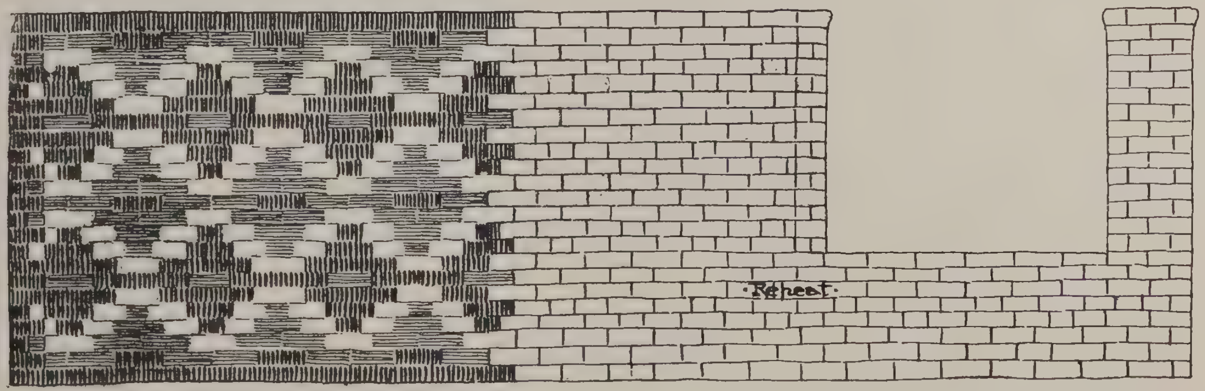


North·Elevation·



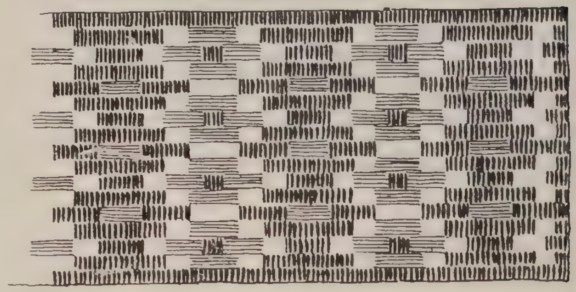
·DESIGNS · FOR · GLAZED · TILE · WAINSCOTS · ·ON · WALLS · OF · PLUNGE · BATH · AT · "CHATWOLD" · BAR · HARBOR · MAINE ·

·Andrews·Jaques·and·Rantoul·Architects·Boston·



South·Elevation·

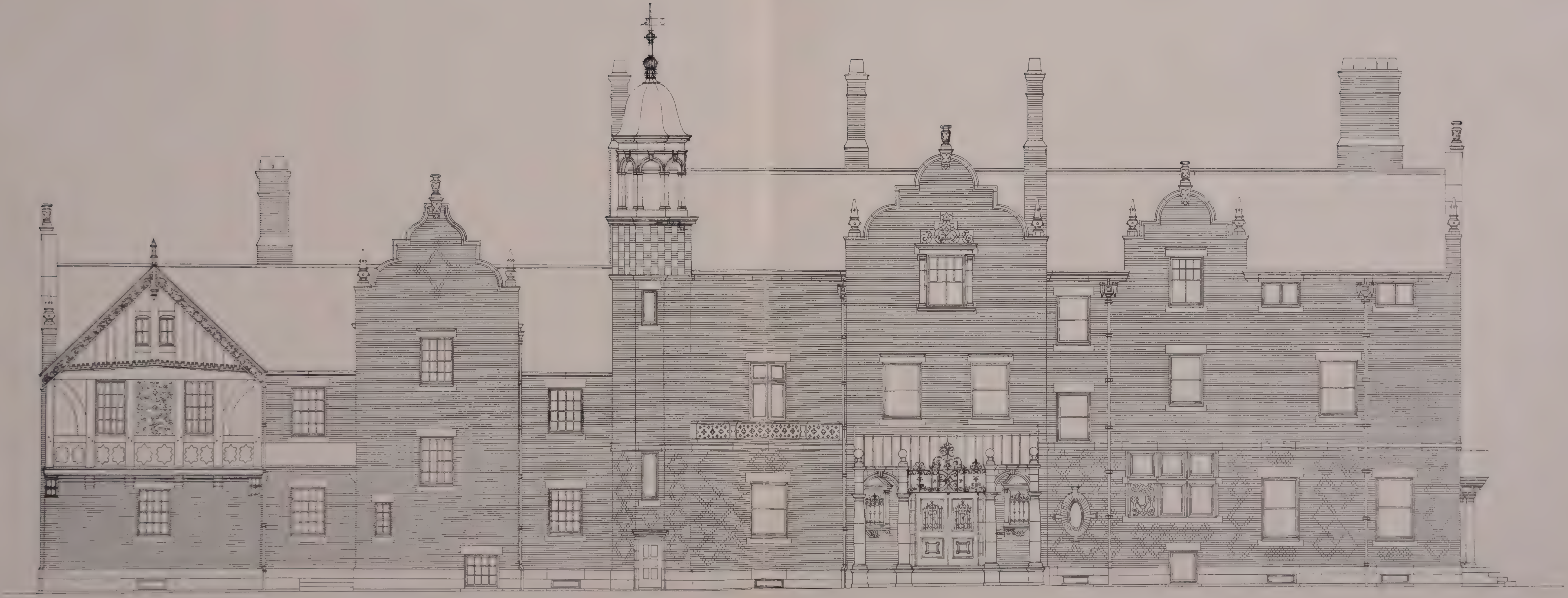
·COLOR·KEY·
- ·Green = ▥
- ·Yellow = ▤
- ·White = ☐
- ·Tiles = 4"×12"·



·For·Lounging·Room·

THE BRICKBUILDER.

VOL. 4, NO. 5. PLATE 35 AND 36.



HOUSE FOR LOUIS CABOT, ESQ., BROOKLINE, MASS.

Sturgis & Cabot, Architects.

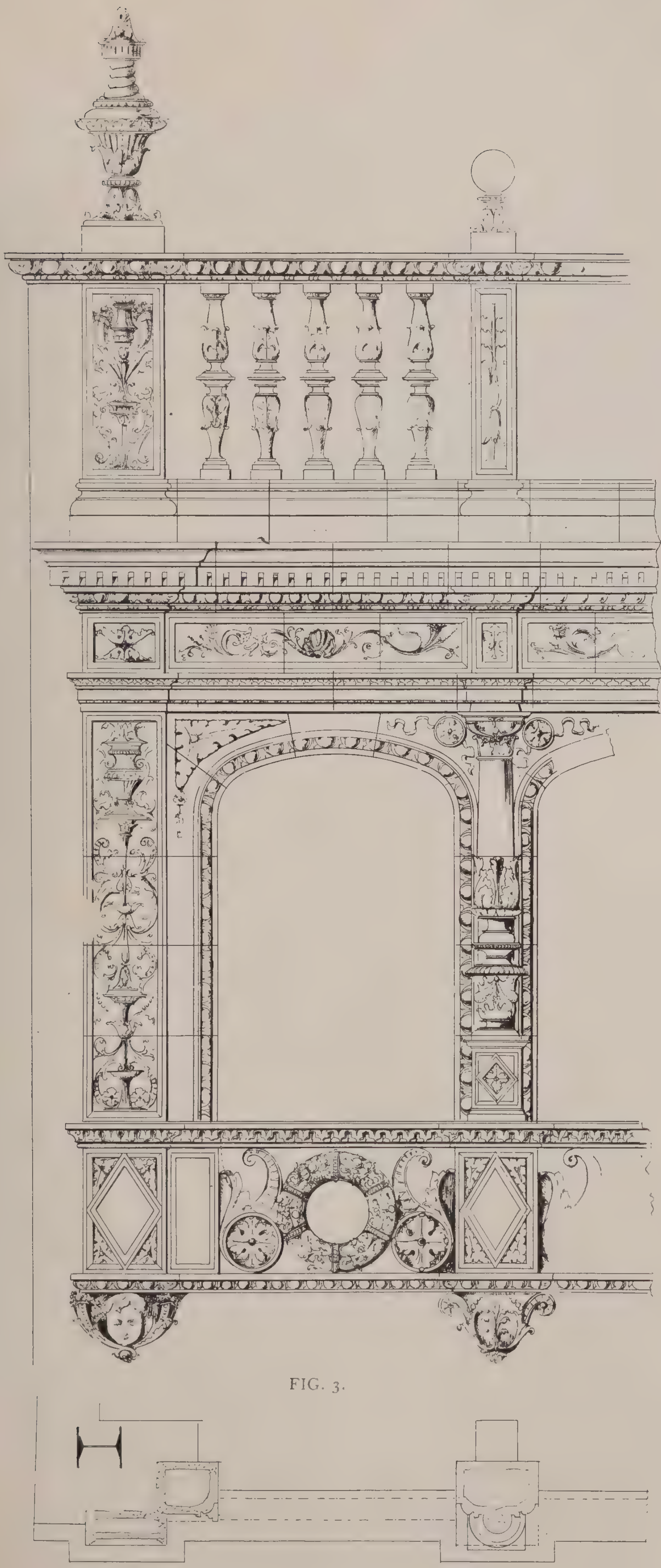


FIG. 3.

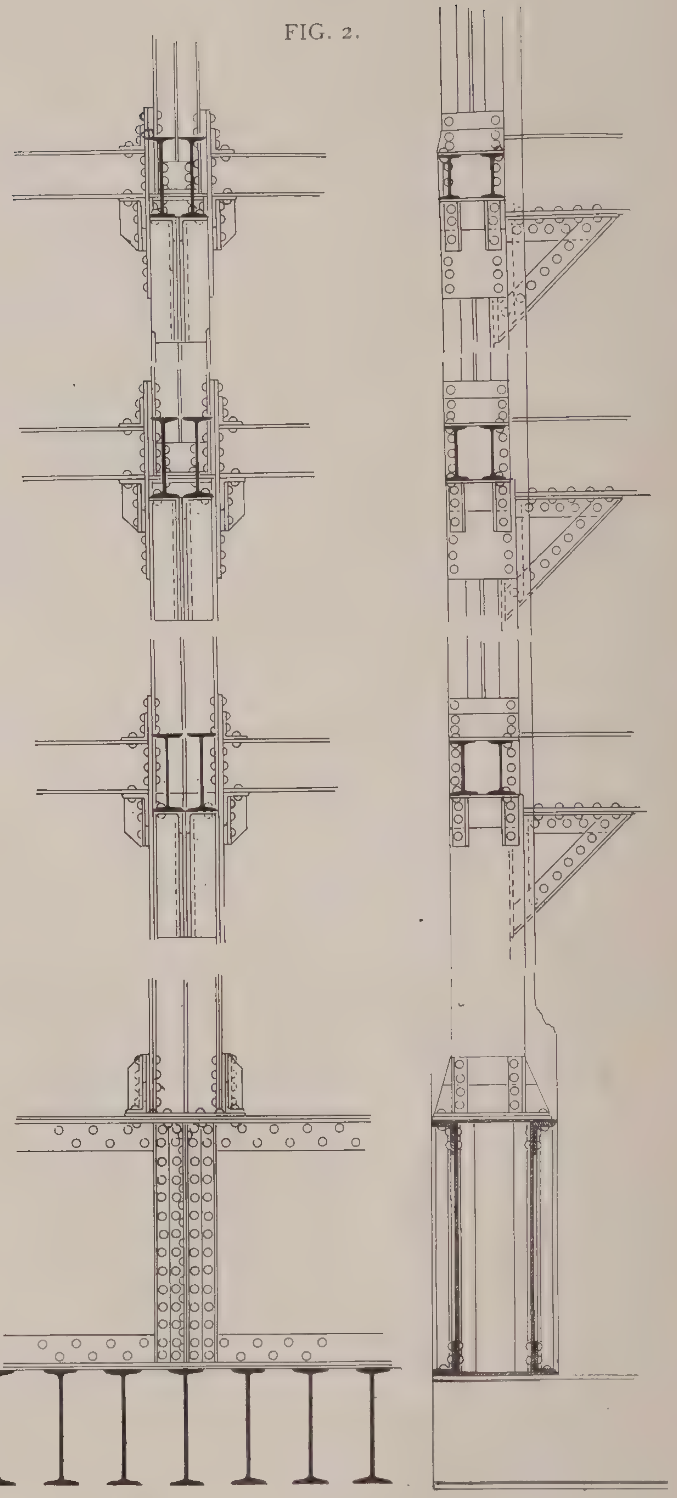


FIG. 2.

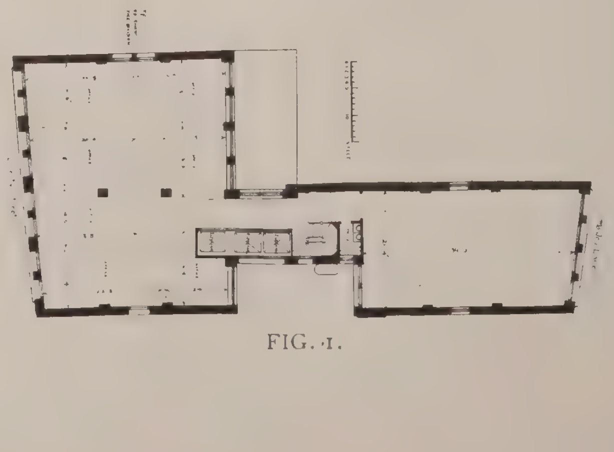
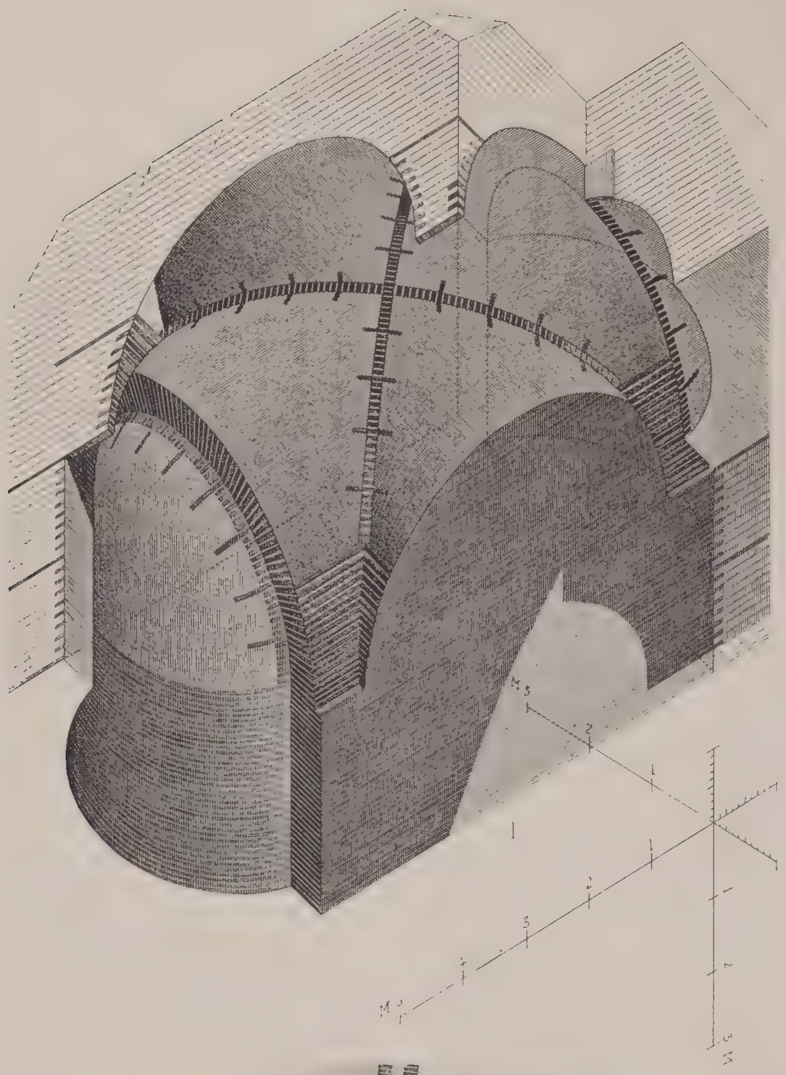


FIG. 1.



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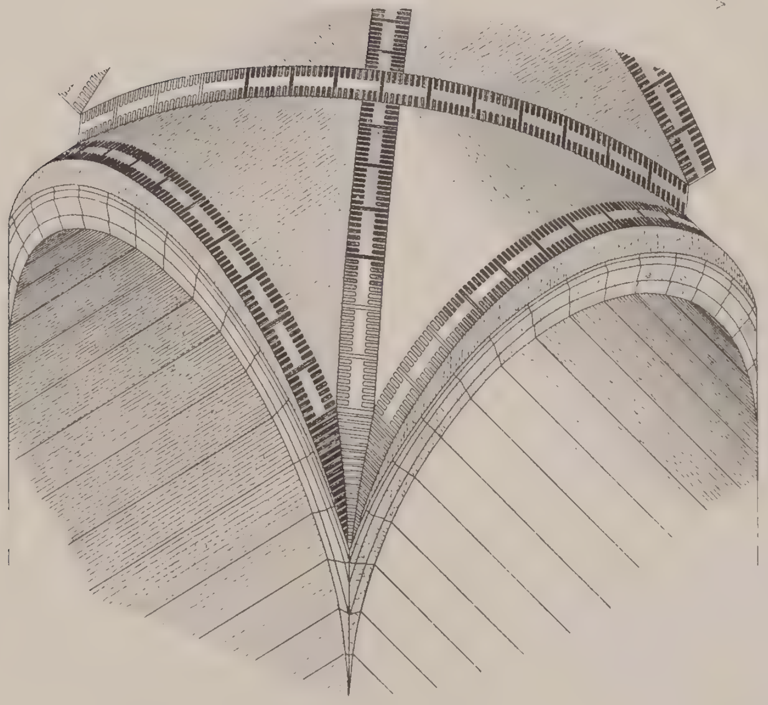

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PLATE VII. THE ART OF BUILDING AMONG THE ROMANS.

HOW TO PREPARE MORTAR.

ENGINEERING, N. Y., March 16, contains a letter from Mr. Edward Wolff, which, in view of recent occurrences in New York, is of interest as showing defective methods of mortar making employed by builders, and as giving the proper method of slacking lime, preserving it in good condition after slacking, and preparing from it strong, adhesive mortar: —

"The slacking operation should be done in a water-tight box made of boards, and so much water should be mixed in that the contents will never get dry, and a sheet of water will remain on top to prevent access of air. If the box will not hold the entire quantity of lime required, the contents may be emptied into a cavity made in the ground close to the pan, and this process may be repeated. This should be done at least two weeks before sand is added, or before the mortar is prepared for use. Slacked lime prepared and kept as stated has been found free of carbonic acid after many years, air and gas having not been able to find access. Instead of following the procedure in slacking lime recommended above, we see in this country, or at least in the neighborhood of New York, a faulty process adopted, which consists in loosely mixing the sand with the slacking lime immediately after water has been added, and forming a dry heap on the surface of the ground, which is left lying there several weeks to give time for complete slacking before the sand is worked in evenly and the mortar considered ready for use. This heap arrangement is perfectly adapted to circulating air through a material which should be guarded against contact with air. The sun heats the surface of it, makes the air escape after it has given up its share of carbonic acid gas, while at the base of the heap and at the shady side a fresh supply enters to fill up the vacuum after it has circulated through the heap and has been robbed of its share of carbonic acid gas. That this procedure really happens in such a heap we can easily see when we place a lump of freshly slacked lime in a wineglass, and in another glass place a small quantity of material taken from a heap such as described, and which has been prepared a few days before; fill both glasses nearly up with water, and add a few drops of muriatic or sulphuric acid to each. In the first glass nothing can be observed, while in the second glass we will see in the shape of small bubbles the carbonic acid escape, which has been absorbed by the lime from the atmospheric air circulating in the heap." It is reasoned that, as the hardening of mortar after mason work results from slow absorption of carbonic acid from the air, if this be allowed to take place to any considerable extent before the mortar is used, a granular and non-adhesive condition of the mortar results, and a strong wall cannot be made with it.

MOVING BRICK HOUSES.

THE moving of immense brick structures is no longer an experiment, for this branch of the building trades has taken its place as one of the exact sciences, says a writer in *The Western Builder*. It is no longer necessary to tear down a valuable structure in order that the ground may be used for a more expensive building or to make a thoroughfare. In these modern days a large and heavy brick or stone house can be moved with the ease with which a piece of furniture on rollers is moved. The old method of tearing down and carting the *débris* to a second-hand dealer was wasteful of good material, but by the new method a house is removed quickly and without disturbing any of its contents. It is not even necessary to stop business operations in the building while the work is in progress.

The method by which these removals are accomplished is a most interesting one. Large timbers are placed three feet apart under the first floor joists and running through the building. Under these are placed a second row of timbers at right angles to the first, and under these last timbers strong lifting jacks are placed about one foot apart. The building is then lifted off the foundation to a proper height to move it. The ground over which the building is to be moved is made perfectly level and covered with boards, on which tracks of heavy timbers are then laid. Maple rollers five feet long are slipped under the timbers in the house, and the moving process is ready to begin.

If the house is a small one it is slipped over greased planks, and rollers are not needed. This method is also employed when the distance to be moved is small. In long moves and heavy houses where rollers are used, the motive power is furnished by a single horse pulling on heavy chains and pulleys so arranged that the greatest amount of power may be had at the least expenditure of force. The new foundation is built up between the timbers, or needles as they are sometimes called. After the foundation walls are built and have dried, the timbers are drawn out one by one and the holes are filled in. The new foundations are always much stronger than the old, because the weight of the house comes on them at once, and they must of necessity be built strong.

EDITOR OF THE BRICKBUILDER:

Dear Sir, — Your "Side Talks with the Builders," in the April BRICKBUILDER, was timely and to the point, and that portion advising young and inexperienced workmen not to be in a hurry to take contract work in the spring was in order and to the point.

Here in this northern country — Canada — the winters are long and severe, and bricklayers and masons have necessarily a long spell of idleness, and of course when spring does set in they are anxious to go to work at the earliest moment possible, and in their anxiety frequently contract for work much below its actual value. A case in point has just come under the writer's notice, one of a great number, and was as follows: A strong company in town desired to erect a large brick building for a sort of annex to their extensive meat-curing factory. Plans and specifications were prepared during the winter, and the contracts were advertised to be let about May 1. Nearly all the legitimate contractors tendered for the work, and a bricklayer who had never had any experience with large contracts tendered also. His figures were so low that the company, who thought the regular contractors wanted to swindle them, gave him the work. Everybody knew, who knew anything about such work, that if the successful tenderer went on with the work it would ruin him. He commenced operations, however, engaged his men, and purchased some of his material, when all at once it dawned upon him that he had taken the work too low. Fortunately the papers had not been completed, and he threw the job up. The company tried to keep him to his bargain, and at last offered him a big sum more if he would go on with the work. He concluded to try it again, did so, this time under the knowledge that he was tied down on paper to complete the work. He discovered the other day that even with the additional sum allowed him he would lose money, so abandoned the work a second time. The company was obliged to have the work done, so were compelled to fall back on the regular contractors, who now command the situation, and the owners have to pay the piper. The first contractor has now got into trouble that may sweep away a lot of money, and he has missed several smaller jobs that were within his capacity as a contractor.

This is one of many like cases that I have met with in my forty years' experience. Men are too anxious to become contractors, and fail to recognize the fact that special qualities are required in a man to make a successful contractor.

FRED. T. HODGSON.

THE American Hoist & Derrick Company, headquarters St. Paul, Minn., have just opened an Eastern office in the Havermeyer Building, New York City, under the management of Mr. W. L. Manson. This is done for the better accommodation of their Eastern trade.

WE have just received a catalogue from J. B. Prescott & Son, Webster, Mass., setting forth the numerous advantages to be received from the use of the Morse patent steel wall ties. This catalogue has a number of very good suggestions upon bonding hollow walls, pressed brick facing, granite facing, also methods of fastening brick veneer by means of their wall tie. Parties interested should certainly send for a copy of this catalogue.

Recent Brick and Terra-Cotta Work in American Cities.

A Department Devoted to the Interests of the Manufacturer.

CHICAGO. — News of some interest to Chicago architects and builders hinged upon the late city election. A change was made from a Democratic to a Republican administration by a majority of forty thousand. Whether the change was from one corrupt administration to another corrupt governing body remains to be seen. But it is very significant that "civil service" was adopted by a vote of nearly two to one. This municipal field is certainly ripe for reform. The city council is notoriously corrupt, and at least one department of the city government, that of building inspection, has become almost a farce.

One incident indicates the degree of efficiency which the building inspection department seems to possess in insuring safe construction. Some heavy loads and doubtful construction were under discussion when the coming of a veteran building inspector (who has been on the force fifteen years he said) was welcomed and his advice was asked, "What do you consider a safe load to allow per square foot on a brick pier of that character?" indicating a heavy pier of common brickwork. The inspector coughed and looked wise and said gravely, "Oh, let me see, — about nine hundred pounds, — yes, I think it ought to carry nine hundred." To those who calculated twenty times that load on the pier in question, the inspector's estimate would seem to be on the safe side certainly. The official, however, knew so much about his business that if any one had said ninety thousand pounds, he would have nodded like a judge and guessed that was all right.

BOSTON PUBLIC LIBRARY. COURTYARD AND FOUNTAIN.

Mottled Brick and Terra-Cotta made by the Perth Amboy Terra-Cotta Company.

Not only are inspectors and other officials ignorant, but flagrant violations of the ordinances have been allowed for a price. One could build a show window a foot or so out on the narrow sidewalk of a narrow congested street in the heart of the city, or build a wall four inches thinner than it ought to be, simply by slipping twenty-five dollars or one hundred dollars into the right place.

Mayor Swift seems rightly determined in civil service intentions. The new commissioner of public works, W. D. Kent, is attracting much attention by his weeding process among city employees, and he has an opportunity to win the lasting favor of Chicago.

One of the best known contractors in the city, Joseph Downey, who, with Mr. D. Adler, the architect, was a member of the committee who draughted the revised building ordinances, has been induced to become the building commissioner, and it is to be hoped that he will feel a double responsibility in seeing the ordinances strictly enforced. At present the dictum of the Board of Underwriters is the only law that seems to command any respect from builders.

May of course is in the busy building season, and while there seems to be a healthy growth in business, yet it is largely true, as one architect remarked, "We haven't a single important building in our office; they are all 'chicken feed.'" The large office buildings which The Brickbuilder intends to illustrate next month will not have many followers to keep them company in the immediate future. Chicago is so well supplied with office space that owners have been known to assume new leases for tenants in old buildings, to induce them to move into the new skyscrapers, where they pay the same or even less rental. In other words, owners are taking the risk of carrying tenants rent free in order to fill the new buildings.

The apartment building business also, in some regions, notably that of the World's Fair site, seems to be somewhat overdone. Experienced investors are requiring gilt-edged security for loans on apartment buildings, or even advising borrowers not to build at all. But Chicago's constant growth will very quickly make the demand as great as the supply of both office and apartment buildings.

There are only three office buildings in prospect, one of these being still in the uncertain stage, and of the other two which are to begin erection soon, the Atwood, corner Clark and Madison, will be carried at present, so it is reported, but a part of its ultimate height.

The temporary Post Office and Government Building, to be erected on the Lake front, is supposed to be nearly ready for letting contracts. The exterior, it is said, will be largely terra-cotta. This building is to be occupied during the construction of the new $4,000,000 Government Building, which will stand on the site of the present notoriously dark and dangerous structure.

Some of the lately finished buildings — the immense Marquette, the Music Building with its Steinway Hall and music studios, and the Rothschild, another addition to the list of big department stores, the new Science building, the Yerkes Observatory, the elaborate new Smallpox Hospital and others, including some new residences — will be spoken of in detail later.

PHILADELPHIA. — The last month has seen some of the largest and most extensive improvements in building. The Horticultural Hall, a description of which was given in your columns some months ago, has been contracted for, and the actual work has been commenced, and is being pushed vigorously; it will give to this city one of the finest buildings of its class in the country, it not being merely a beautiful shell upon the exterior of which all the ornament has been lavished, and nearly all the money spent; on the contrary, the interior of this building receives its full share of the study, treatment, and expenditure; is in perfect harmony with the exterior, and makes the whole a thoroughly consistent and harmonious production; the exterior is of brick and terra-cotta, with an especially rich frieze which will be treated in color; the ornament is rich and bold, and considerable skill has been shown in the placing of it just where it will count for the most in the design, without overloading the façade, as has recently been done in some of the latter terra-cotta buildings.

Within a few hundred feet from the Horticultural Hall are at present being laid the foundations for the new Metropole Hotel, which will be a steel frame building with walls of brick, stone, and terra-cotta; it will be large and imposing, and the contractors wish to make a record for speed in the construction of the work, and consequently are at it day and night. Rumors are afloat to the effect that it is to be in condition for business before the first of the next year.

The large Dormitory Building, or rather series of buildings, which will be erected during the summer for the University of Pennsylvania will soon be ready for the bidders. The present scheme for the buildings shows probably the most extensive system of dormitory buildings ever attempted as a whole by any institution of a similar kind; about half of the entire scheme will be built this summer, and the remaining parts are all expected to follow at once. They are of brick and stone, in the style of the English Renaissance, very elaborately ornamented, and will be strictly fireproof throughout. The composition and grouping of the different parts of the scheme are excellent; the Dining Hall, Administration Building, Chapel, etc., being placed in prominent positions, which add very materially to the composition as a whole. By studying the design, one is impressed with the manner by which the architects have avoided the least appearance of the painful monotony which is so frequently seen in large operations, while at the same time, by a certain amount of repetition, they have added very materially to the strength of the composition. It might be well for some builders, and, for that matter, also architects, who plan and erect entire blocks of residences at one operation, to study seriously the grouping and especially the planning of these buildings.

RESIDENCE OF EDMUND HAYES, ESQ., BUFFALO, NEW YORK.

Green & Wicks, Architects.

The Mottled Fire-Flashed Pompeian Terra-Cotta which was used with fine effect in this Building was furnished by Fiske, Homes & Co.

The opening of the new Mercantile Club Building, which occurred several weeks ago, has had its effect upon the minds of the public. It will undoubtedly advance the methods of brick and terra-cotta construction as set forth in the façade of the building, and must be far reaching in its effect, since the club is made up of many of the best and most prosperous merchants of the city. The building was kept open to the public for an entire week; everybody interested in any manner in building, who was able to obtain the necessary passes, went to see it; all came away pleased, and much of the prejudice against terra-cotta as a building material must have been removed. The building is spacious and elegant, and exhibits an unusually large and imposing façade, executed in buff brick and terra-cotta.

ROCHESTER. — If the work being done in architects' offices is an indication of better times, there must be a very marked improvement here this month over last. Nearly all the offices are "busy just at present"; and although an architect of long experience has said that this season would keep architects rushing, trying to find enough work to pay office expenses, other architects seem to think differently.

There is a great deal of competition going on lately. The theatre at Charlotte, which will cost about twenty thousand dollars, was won by Mr. George T. Otis; and it is said that the Normal School at Geneseo, which was expected to go to Mr. Foote of this city, has been given to a Mr. Longfellow of Boston. The Union School at Wolcott is about to be awarded to some one, as a meeting at which plans were to be submitted was held Saturday, May 4. Several designs will be submitted from this city.

Work on the new Court House has been started again, and is being rapidly pushed forward.

In all probability there will be no strikes by the labor unions this spring, as about half of their members are so busy *striking* contractors for jobs, that they will have no time to attend to any other kind of strike, and it is even being said that "walking delegates," much as they dislike work, are looking for something to do.

Work now on in the offices, about to be let, or which has just been let, is as follows: Contracts have just been signed for block for Mr. Philip Christman, Lyell Avenue, by Kay Brothers and George B. Garrison; pressed brick furnished by New York Hydraulic Pressed Brick Company; architect, George T. Otis. House of Mr. Thomas Levis, New York hydraulic pressed brick, cost fifteen thousand dollars; architects, Kelly & Headley.

Kelly & Headley have also let contract for brick block on North Clinton Street to Dominick Kraft, and have plans of church for "Holy Apostles" Congregation; stone and brick; estimated cost, $40,000.

George F. Hutchison, architect, has let contract for Town Hall at Caledonia to R. G. Porter of Buffalo, and is preparing plans for residence for Mr. Emmett Craig. New York hydraulic pressed brick will be used for both of these buildings.

Messrs. Fay & Dryer, architects, are making plans for an apartment house to be built for the Proctor estate; there are to be three stories, all the improvements, including a pressed brick front, furnished by the ever-reliable New York Hydraulic Pressed Brick Company.

The First Methodist Congregation have decided to erect a new church; and Rev. M. R. Webster, A. L. Thompson, and Geo. B. Watkins have been appointed a committee to secure plans. A large and costly edifice is contemplated.

Gordon & Bragdon, architects, have dissolved partnership. Mr. Bragdon will travel abroad.

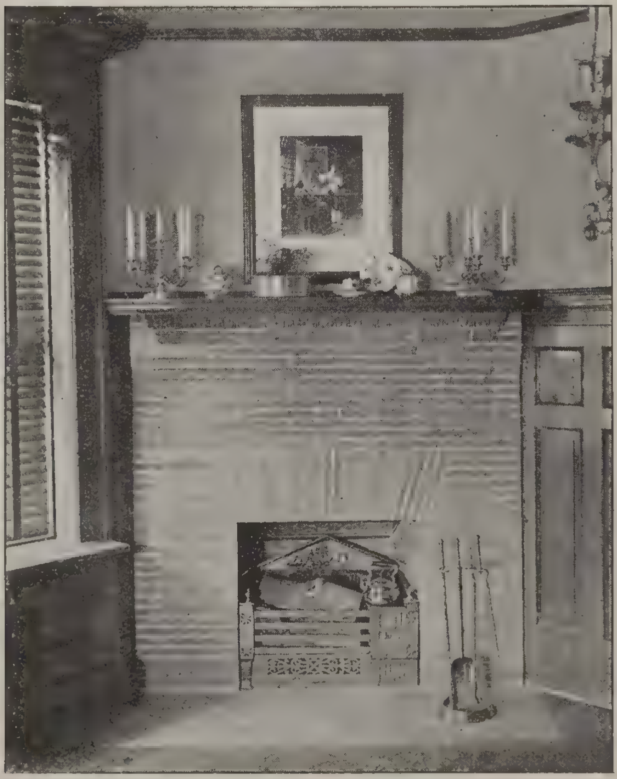
DETROIT. — After a long siege of idleness for the contractor, spring has opened with most encouraging results in the building line, in fact to such an extent that the journeymen have demanded union wages, with prospects of a strike in case of refusal; this leaves the contractor uncertain how to figure with a number of large contracts about to be let, one of which is Mabeley & Company fourteen-story building, to be erected on the most valuable piece of property in Detroit, and also two steel fireproof pressed brick buildings, the larger, the Union Trust Building, being ten stories in height, and the Masonic Temple, which has more, as well as the most elaborate terra-cotta detail than anything ever attempted in this city.

BRICK MANTELS AND FIREPLACES.

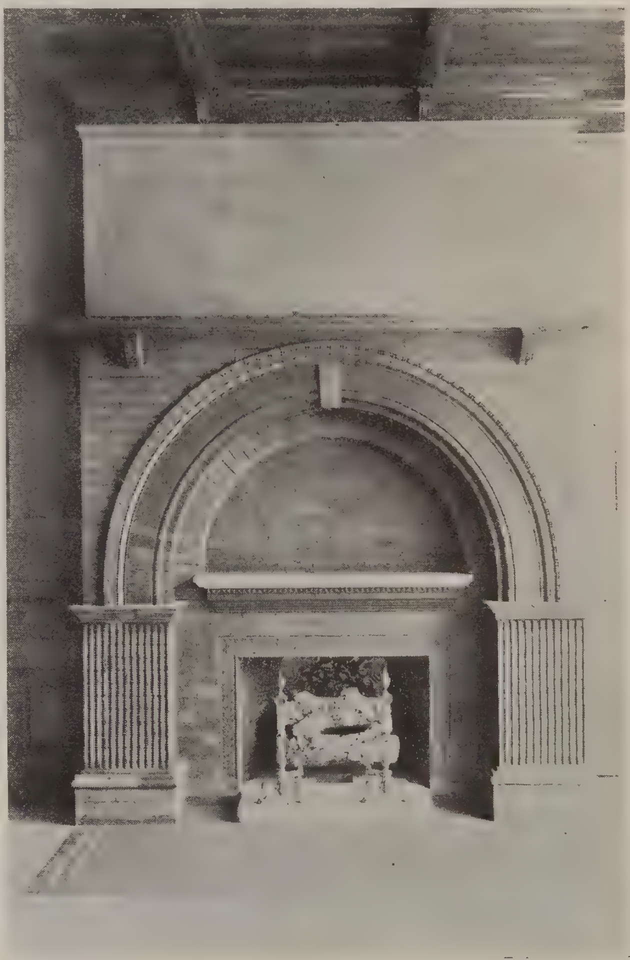
NOW that hot-air furnaces and radiators have, in some degree, been relegated to their properly subordinate position, and wood fires have been rekindled on our hearths, it is pleasant to glance at and consider the increased number and richness of materials available in the building of the centre of the home — the fireplace. We publish herewith several illustrations of fireplaces, mantels, and chimney-pieces, the materials of which are almost wholly brick and terra-cotta, as made by The Central Press Brick Company, Cleveland, O.

Since "practicable" fireplaces have come back into favor, and are demanded in the smallest and largest homes, the owner and architect are no longer confined to the use of the plain regulation size, red brick. Not only have bricks been made in many sizes, but the forms and colors have been endlessly varied, so to-day it is possible to select bricks of the proper scale to fit a small private room, or a room large enough to be adapted to public uses.

The color scheme of a fireplace can now be made to harmonize with the coloring of the room either by adopting one color for all the brick used, or by selecting several shades of the same color or different colors, and getting the desired effect by lines, panels, or diapering. So many colors and shades of bricks are produced that no harshness or crudeness need result from the introduction of more than one color in the same piece of brickwork. Red, black, yellow, gray, and white brick and beautifully delicate colors and shades of the same, produced by varying mixtures of two or more colored clays, add to the richness of the storehouse to be drawn from.

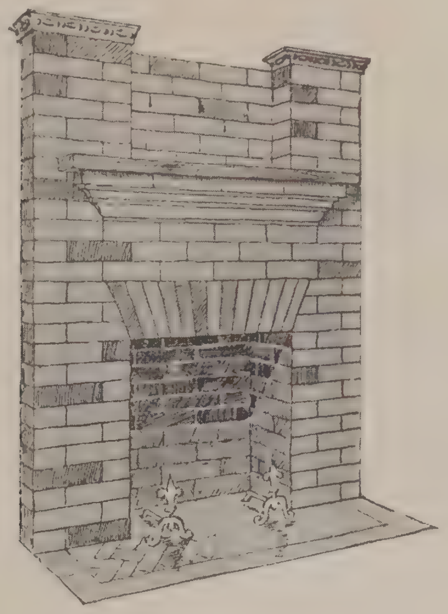


The forms of bricks are now only limited by the inventive powers and the taste of the designer. Ordinary straight brick are thin or thick, short or long, wide or narrow, as needed for any case. Then too the bricks are curved on the face, moulded, decorated with dentil, dogtooth, egg and dart, or other appropriate form, or may have the surface covered with delicate arabesques. With this variety it is possible to build fireplaces and mantels suited to modest domestic work or to rooms having a monumental effect.



Brick, and particularly that made wholly or in part of fire clay, is a material peculiarly adapted to fireplace work, having in its manufacture passed through and proved itself capable of resisting fire; while marble, iron, and stone too often succumb to a moderate degree of heat. Iron twists if wrought, cracks if cast; stone splits or chips; marble turns to lime, or the wax with which its imperfections are concealed slowly fires out and leaves the once beautiful surface pitted as with smallpox. Brick endures longer than any material used in fireplaces.

The architect when called upon to construct a fireplace of brick will consider the material and its limitations in form and dimensions. If the material is to be brick, the parts will necessarily be small, and the designer will be led naturally to adopt some form of arch for covering the fireplace opening, as the arch is the proper constructive form, requiring no concealed aid for its support. If a plain row of stretchers is placed over the opening of a fireplace, it must be supported by iron in some form, generally a flat wrought bar. This construction is far from satisfying to the eye, as the bar is generally concealed, and the law of gravitation seems to have been defied; but the outraged law has its revenge the first time that a somewhat hotter than usual fire is kindled, for then the iron bar expands as heated, and contracts as the fire goes out, having in the mean time moved the bricks above, causing disfiguring and permanent cracks and dislocations. With the arched form of fireplace no such unhappy result need ensue; the brick having during its birth passed through a fiery furnace is now affected so little by extremes of temperature that once solidly placed on a good foundation, a brick fireplace and mantel should remain perfect as long as the building endures in which it stands.



REMARKABLE ACTIVITY IN BUILDING.

TWICE AS MANY NEW BRICK BUILDINGS AS A YEAR AGO.

A COMPARISON of the permits for new buildings granted this year with those of a year ago and preceding years shows a sensational increase in building this year over 1894, and more of it than any of the past five years, excepting 1892, which is nearly equalled.

The following table, compiled for this column, shows the new structures for the first four months of this year and a year ago: —

	Brick.	Wood.	Total.
1895	86	279	365
1894	13	142	155
Increase	73	137	210

It will be noted that the brick buildings number between seven and eight times as many as last year, and that the frame structures have nearly doubled, the total increase being 210, against a total number last year of 155. This is truly a remarkable exhibit, and proves the great activity in building in Boston.

The following table will show at a glance the permits for new work during the first four months of the last five years: —

	Brick.	Wood.	Total.
1895	180	569	749
1894	91	458	549
1893	150	502	652
1892	91	665	756
1891	99	438	537

This year leads last by just 200, and the brick buildings are very nearly double in number. In this class of construction this year is far ahead of any of the others; in frame it falls behind only 1892.

The number of brick buildings completed during the months of February, March, and April was 76, costing $1,265,607, against 22, costing $478,640, a year ago. The frame buildings completed numbered 305, costing $1,614,085, compared with 153, costing $530,175, for the corresponding period of 1894. — *Boston Herald*, May 2.

THE EAST AHEAD THIS YEAR.

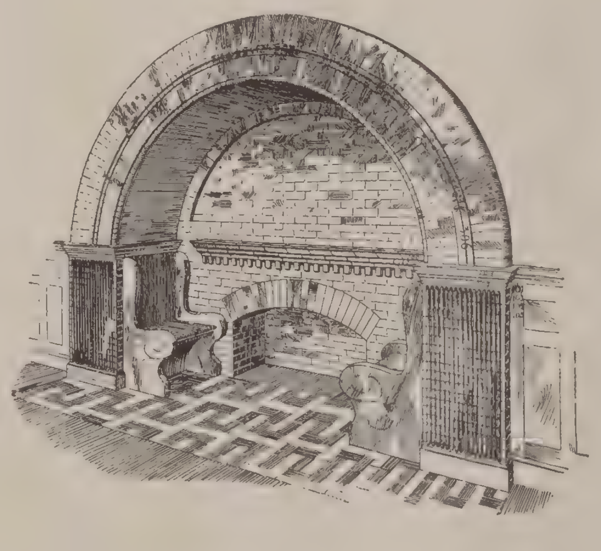
A CHICAGO builder, who keeps run of construction in different parts of the country, thus sums up the operations in the principal cities in an interview in the Chicago *Times-Herald*: —

"The indications, as I have watched them during the first four months of 1895, show that those cities with the greatest percentage of 'home' capital are doing the greatest amount of building this year. The cities which head the list are New York, Philadelphia, and Boston, in the order named. Of the cities in the central West, perhaps Detroit is doing as well as any, and favorable reports come from Buffalo and New Orleans.

"As I remarked recently, this is not a year for the young giants of the Mississippi Valley. The year 1895 will pass into the history of building operations as an 'Eastern year.' Such cities as St. Paul, Kansas City, Minneapolis, Denver, Omaha, and Duluth are likely to jog along quietly this year. As a Minneapolis man remarked the other day, 'We are taking a little rest out our way this year, waiting for the Eastern cities to catch up.' Yet many cities of the central West are doing fairly well this season, and building operations will never come to a standstill in Chicago, or St. Louis, or Milwaukee, or Cleveland.

"Another important characteristic of the season is the advance in the price of iron. The Carnegie people and other concerns in Pennsylvania and other States have voluntarily advanced the wage scale, and building bricks and other largely used material staples have sustained an advance in price. It therefore costs more money to build in 1895 than it did in 1894, but there is more money afloat to pay for it than during 1894 or 1893. The bull movement is on."

MEASURING BRICKWORK. — Ordinary bricks are about eight inches in length, and, with a mortar joint, about half that in width, so that each brick on the flat will give a horizontal surface of about thirty-two square inches, or four and a half bricks will cover one square foot. As ordinarily laid, there are nine courses to every twenty-four inches, or four and a half to the foot; four and a half courses, with four and a half bricks to the course, will give twenty and one fourth bricks to the cubic foot. Waste, cutting, and close joints will easily require an allowance of twenty-one bricks per cubic foot, which will be found a very convenient figure for estimating the number of brick required for a wall of given height and thickness, as it thus becomes unnecessary to find the cubic contents of the wall, but merely to multiply its face area, or the product of its length and height in feet, by seven fourths of its thickness in inches, which, as the thickness is always some multiple of four inches, is a very simple process. — *Boston Journal of Commerce.*



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VOLVME
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NO·6

THE
BRICKBVILDER

OFFICE
85
WATER
STREET
BOSTON

THE BRICKBUILDER.

AN ILLUSTRATED MONTHLY DEVOTED TO THE ADVANCEMENT OF ARCHITECTURE IN MATERIALS OF CLAY.

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PUBLISHERS' STATEMENT.

No person, firm, or corporation, interested directly or indirectly in the production or sale of building materials of any sort, has any connections, editorial or proprietary, with this publication.

THE purpose of The Brickbuilder is not to look out for the interests of any particular class of its patrons. It considers equally the interests of the manufacturer and those of the consumer. It aims, among other things, to act as an intermediary between architect and manufacturers, and in pursuance of this aim it proposes to bring to the notice of the latter the special requirements and desires of architects, as well as to acquaint architects with the various products of the manufacturers. In the matter of brick, for example, it is undeniable that manufacturers and consumers are, in certain instances, working at cross purposes, the architect desiring brick of certain color, shape, and surface which the manufacturers do not supply; they, on their part, providing certain grades of brick for which many architects have no use whatever. For the good of both parties, The Brickbuilder proposes to print a selection of short articles by its various editorial writers, among whom are numbered many of the most eminent architects in this country. These articles will give the ideas of their authors as to the brick now in the market, and we are confident that their comments will be of extreme use to the brick manufacturers, as indicating the kind of material for which there is an increasing demand. The following is the first of this series of articles.

COLORED BRICKS.

THE use of colored bricks in the United States is a matter of recent introduction, but in Europe it is as old as brick construction itself, and for the reason that no method of ornamentation is at once so cheap and so effective. A wall of brick of good color and character is a fine thing, but in large masses the material is apt to be a little wearying, unless varied by patterns in color and specially shaped or arranged brick. In this country the trouble has been that builders have not been content with slight variations, but have sought for startling effects in sharp contrasts, and their success has been so great that the whole matter has fallen somewhat into disrepute. In their search for loud and vulgar effects, the manufacturers have done them good service, and the market is crowded with violently colored bricks that from an artistic standpoint are of no earthly use. The first so-called mottled brick were good, and are used in the Tiffany House in New York with admirable effect; not content with this moderate degree of variation, however, many manufacturers have exaggerated the peculiarities of mottled brick out of all reason, and, as a result, we are confronted with hundreds of structures which are horrible to look upon, so hideous is the yellow of the brick and so violent and uneasy its marking. These bricks are unmitigatedly bad, but it is unfortunate that their wretchedness should prejudice people against all kinds of mottled brick, for there are many varieties that are exceedingly beautiful, those, for example, which are used in the rear wall of the Boston Public Library. It is only necessary that a mottled brick should be low in tone, with small, unnoticeable spots, for it to be a very useful and beautiful building material.

In the plain colored bricks there is a constant increase of new shades, many of them exceedingly good. Different lots can be obtained varying very slightly in tone, and these are particularly useful for diaper work. There are varieties of a light rosy brown, rough surfaced brick made in St. Louis that can be used with fine effect, and there is another gray brick made in Detroit or its vicinity which is durable and excellent in color. These grayish and pinkish bricks are admissable, not only for exterior but interior work, and they may very possibly be the things the architects have long sought for for church interiors, where red, yellow, and mottled bricks are absolutely out of the question. For this purpose a brick of natural color and even tone is absolutely necessary, and if these gray and rose brown bricks named above could only be made in very large sizes they would prove a great boon.

For external work most of the fancy colored bricks now made are so smooth that they are objected to by many architects. Surface seems absolutely ignored by the manufacturer, and vivid color appears the object of their labors. This is unfortunate, for a brick must have a more or less uneven surface unless it is to look insignificant. The yellow "Colonial" brick recently so much in vogue would not be quite so repellent were it not that its surface is absolutely uncompromising.

There is undoubtedly a big demand for just this sort of brick, or else it would not be made, and the same is probably true, although it is hard to believe, of chocolate colored brick. If architects knew more widely, however, of some of the very delicate bricks that are obtainable, and if the manufacturers would give them good colored brick with rough surfaces, the public might be brought to see how inexpressively ugly are their cherished mottled and speckled abominations and their shiny yellow affairs. Then they might demand something better, and architects would be able to combine delicate colors in a way that would be extremely effective.

Colored brickwork is too beautiful a thing to be thrown away just because speculative builders are running riot with old gold and Colonial colored brick, and one good example of carefully combined

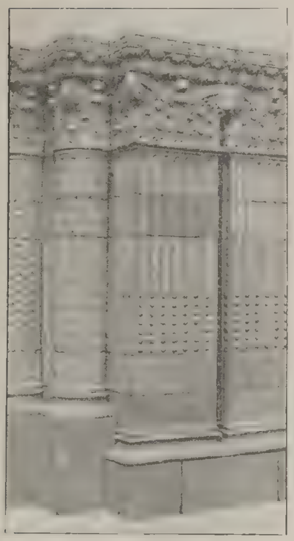
colors will do much towards stemming the tide that is now set in towards vulgarity.
R. A. C.

IN the July number we shall begin Part II. of Mr. Dillon's translation of Auguste Choisy's "The Art of Building Among the Romans." Part II. will be found to be even more interesting than Part I., and contains fully as many illustrations, the larger of which will be printed on the coated paper form.

MR. WM. CONNORS, Troy, N. Y., the well-known manufacturer of "American Seal" Mortar Stains and Roofing Cement, will hold through the columns of THE BRICKBUILDER a competition for the best design for an advertisement to be used in THE BRICKBUILDER. The full program will be given in our July number.

THE preliminary work of judging the designs submitted in the City House Competition is well under way, and we shall be able to announce the winners in our July number. As there were some fifty or more designs submitted, the work will be necessarily slow. Messrs. C. H. Blackall and H. Langford Warren have consented to act as judges, and we are reasonably sure of securing the services of another eminent architect, who at the present time is out of the city.

OUR ILLUSTRATED ADVERTISEMENTS.



LAST month the advertisement of the Hydraulic Press Brick Company gave a view of the entrance to the upper church of St. Francis at Assisi. This month the entrance to the lower church is given. (See page xix.)

The church and monastery of St. Francis form the most prominent feature of the town of Assisi, which stands on the mountain-side overlooking the Valley of the Tiber.

The position of the church on the side of the hill has been taken advantage of by the builders to construct an upper and a lower church, both entered on a level from public squares, which are connected by a splendid flight of steps.

The lower square, surrounded by an arcaded loggia, the entrance of the lower church, and the great bell tower are shown in this month's illustrations.

The church was built in 1228, and is one of the earliest examples of the Gothic style in Italy.

On the opposite page (xviii.) the New York Architectural Terra-Cotta Company illustrate a church of the nineteenth century, in fact, one only recently completed, of which H. F. Kilburn is the architect.

The beautifully moulded terra-cotta (examples of which we illustrate herewith) used in this church was executed by the New York Company.

COMPETITION.

WE are authorized by the New York Architectural Terra-Cotta Company to announce a competition for the best design for a full page advertisement to be used in THE BRICKBUILDER. The drawings must be made in line with black ink on sheets cut to the uniform size of 14 by 18 inches. For the best designs there is offered a first prize of $50, a second prize of $25, a third prize of $15, and a fourth prize of $10. The prizes will be awarded by a jury of three architects of acknowledged reputation. Each drawing must be marked with a motto or cipher, and a sealed envelope similarly marked containing the full name and address of the designer must accompany the drawing. These envelopes will not be opened until after the award is made. The designs for which prizes are awarded will become the property of the New York Architectural Terra-Cotta Company. THE BRICKBUILDER reserves the right to publish the successful designs. Other drawings, at the conclusion of the competition, will be returned to the competitors. Drawings must be delivered flat, express or postage prepaid, at the office of THE BRICKBUILDER not later than October 1.

TO DRAUGHTSMEN.

ANY draughtsman out of employment, who will send us his full address and answer the following questions:—

By whom were you last employed?
Can you furnish good recommendations from your last employer?
On what particular line of work have you been engaged?
What salary do you expect to receive?
Are you willing to go to another city?

may have his name placed in our Exchange Bureau, and will be notified of any parties desiring his services as a draughtsman.

All such communications will be regarded as confidential, and no charge will be made.

Address,
EXCHANGE BUREAU,
THE BRICKBUILDER PUBLISHING CO.

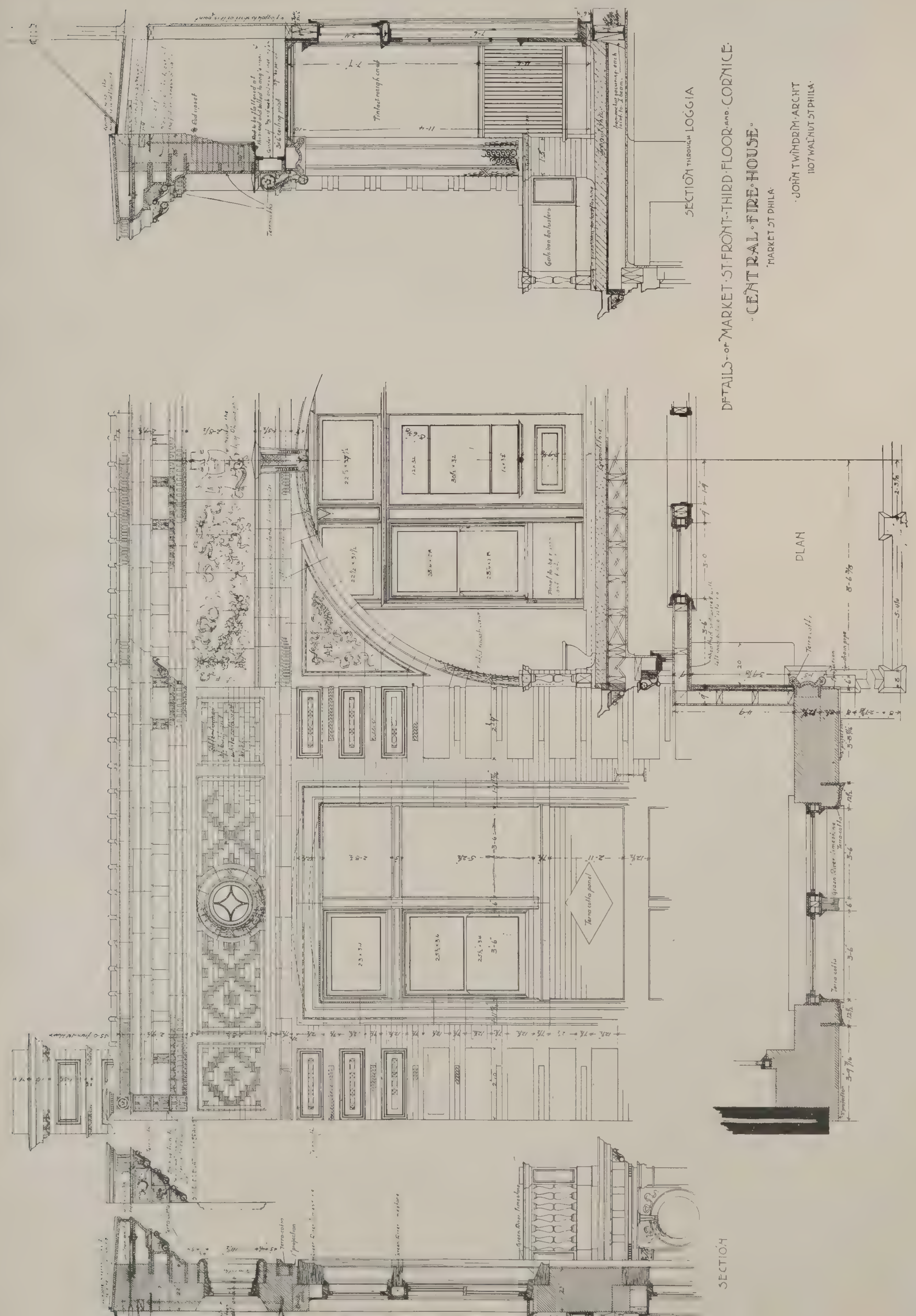
TO ARCHITECTS.

WE call your attention to the foregoing announcement, and upon your application would be pleased to put you in communication with any draughtsman whom we think would meet your requirements. All ommunications will be regarded as confidential, and no charge will be made.

Address,
EXCHANGE BUREAU,
THE BRICKBUILDER PUBLISHING CO.

THE most important feature in the park systems of Chicago which the city has ever considered is now in a fair way to be settled. This is the project to fill in the water front opposite the business center of the city, and make a "lake park" beyond the present shore line, which is occupied by railroads. The plan is to depress the railroad tracks, and then bridge over to an artificial park, as great in area as Jackson Park. The city will have to build a retaining wall of piles, at a cost of perhaps $150,000. The contractors on the big drainage canal are glad to have this water space for a dumping ground for a million yards or so of earth, and the city will soon be the possessor of ground valued anywhere from $3,000,000 to $15,000,000; a beautiful water front whose value to the city cannot be measured, and a site for a great museum, and, possibly, the Crerar Library, an exposition building, an armory, a great maneuver ground, and, in short, a park for the people.

THE annual exhibition of the Chicago Architectural Sketch Club, just closed, was a very successful one. Not only were the local architects well represented, but there were contributions from the East. Some of the sensible designs for school buildings made by Boston's city architect were on view, and it is to be hoped that future schoolhouses in the West will be the better for Mr. Wheelwright's influence.


SECTION THROUGH LOGGIA
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· JOHN T WINDRIM · ARCHT
1107 WALNUT ST PHILA ·
PLAN
SECTION
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Terra cotta
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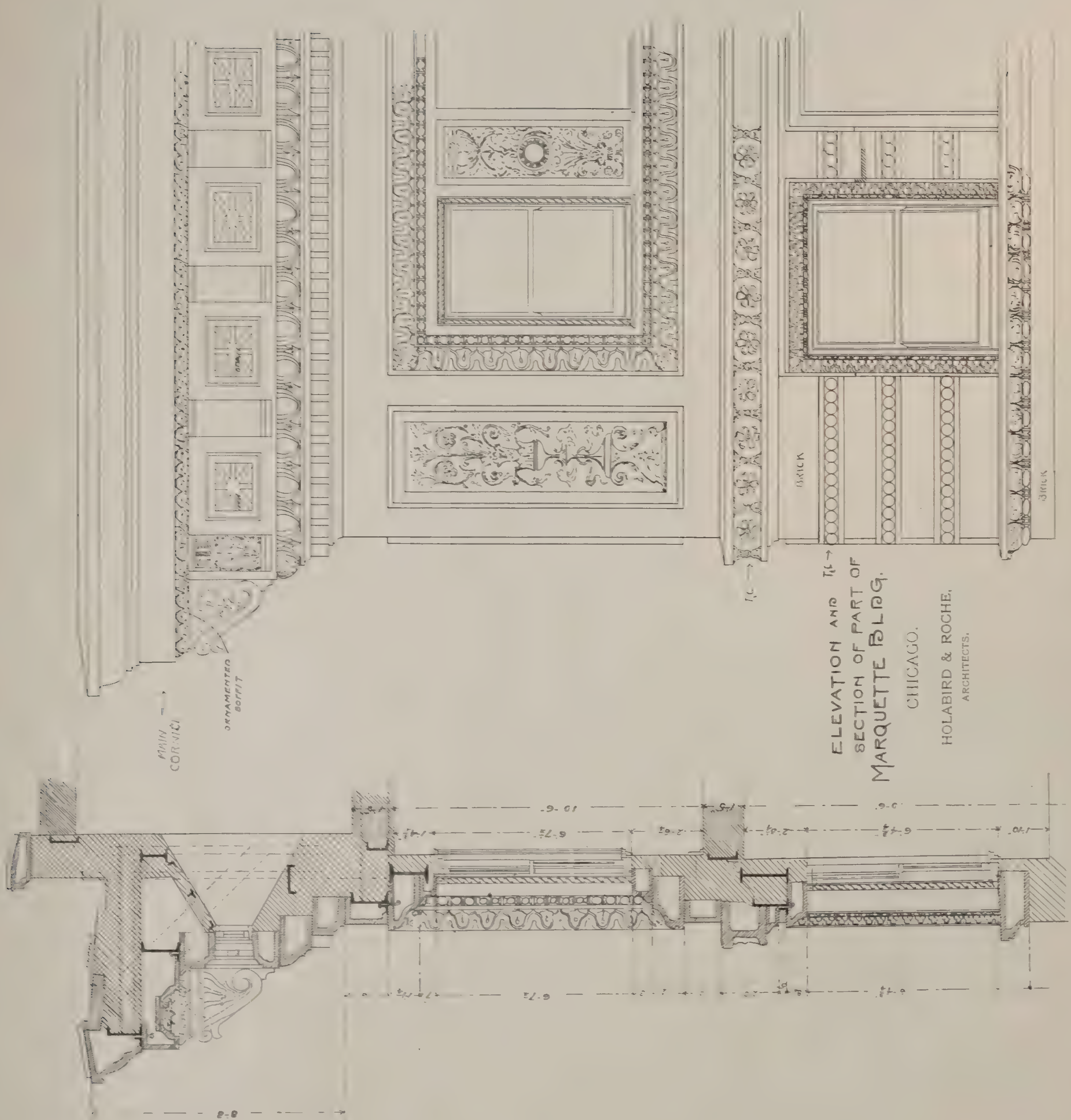
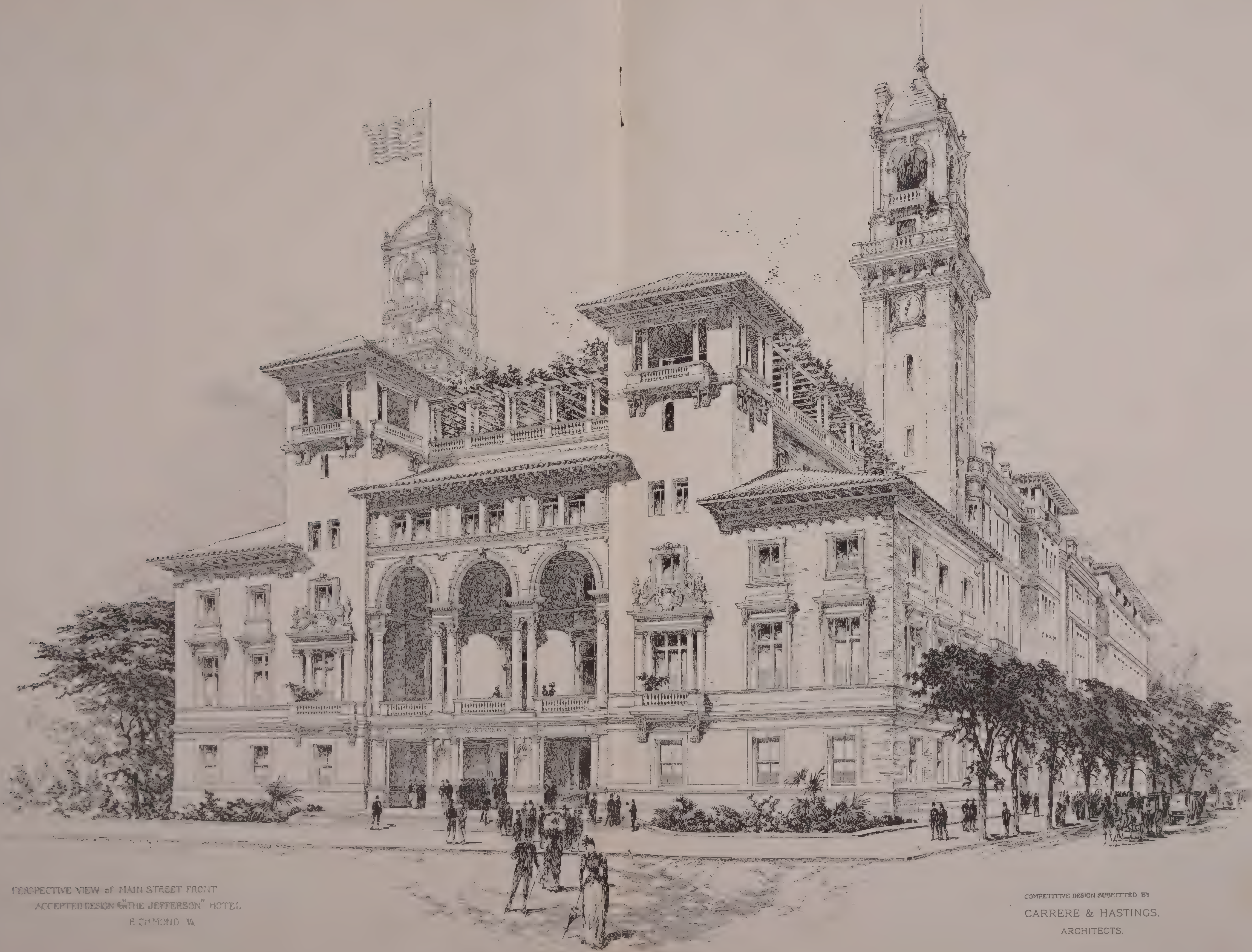


ELEVATION AND
SECTION OF PART OF
MARQUETTE BLDG.

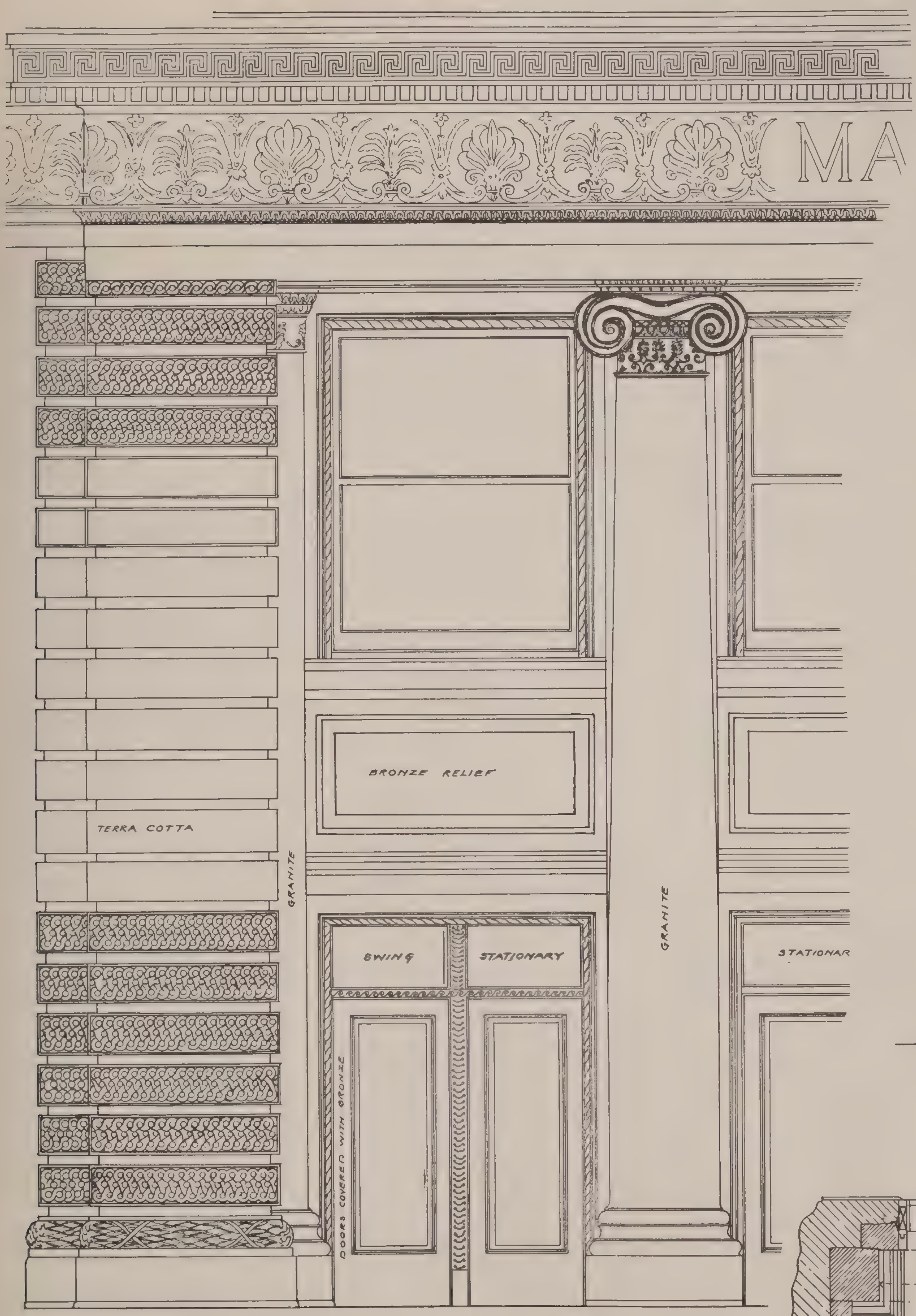
CHICAGO.

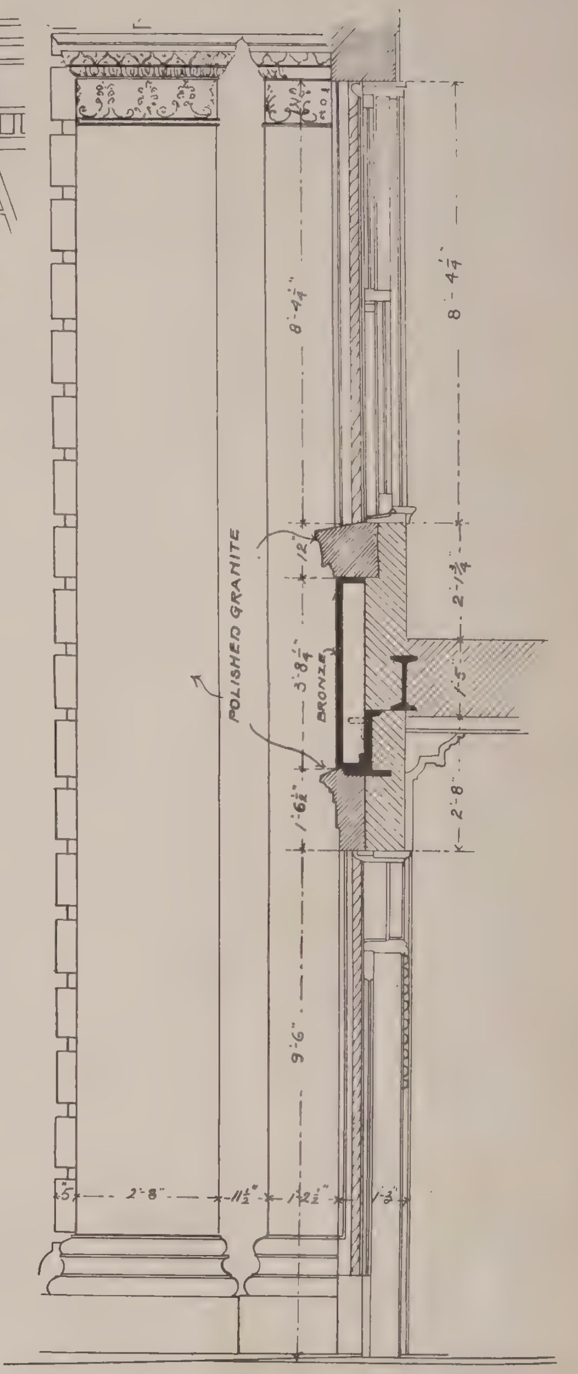
HOLABIRD & ROCHE.
ARCHITECTS.

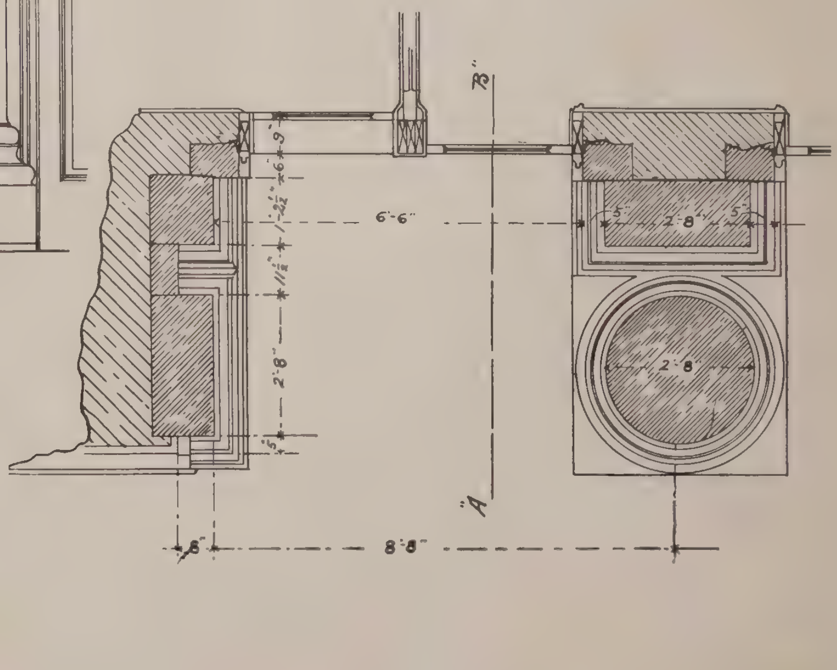


PERSPECTIVE VIEW of MAIN STREET FRONT
ACCEPTED DESIGN for "THE JEFFERSON" HOTEL
RICHMOND VA

COMPETITIVE DESIGN SUBMITTED BY
CARRERE & HASTINGS,
ARCHITECTS.

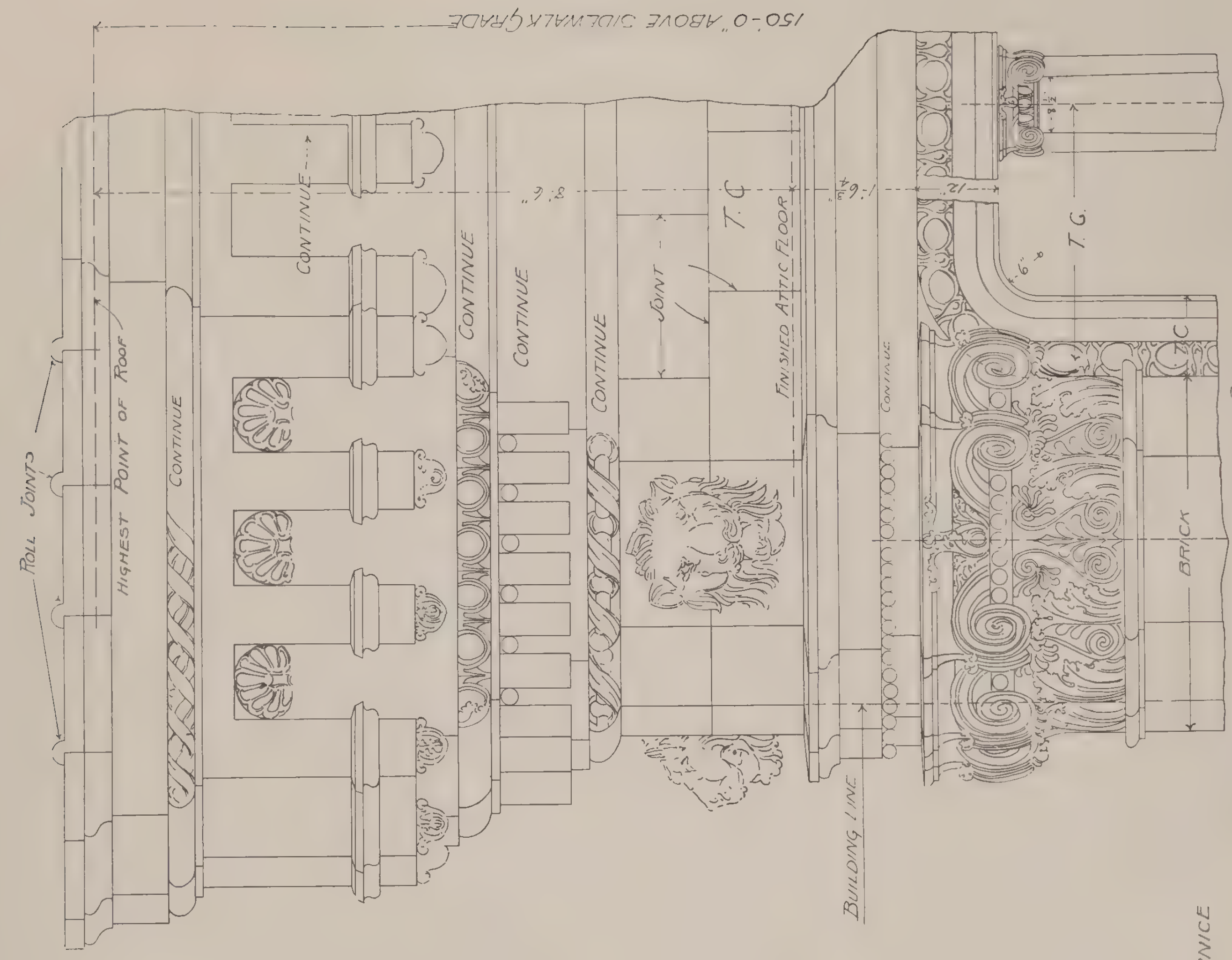




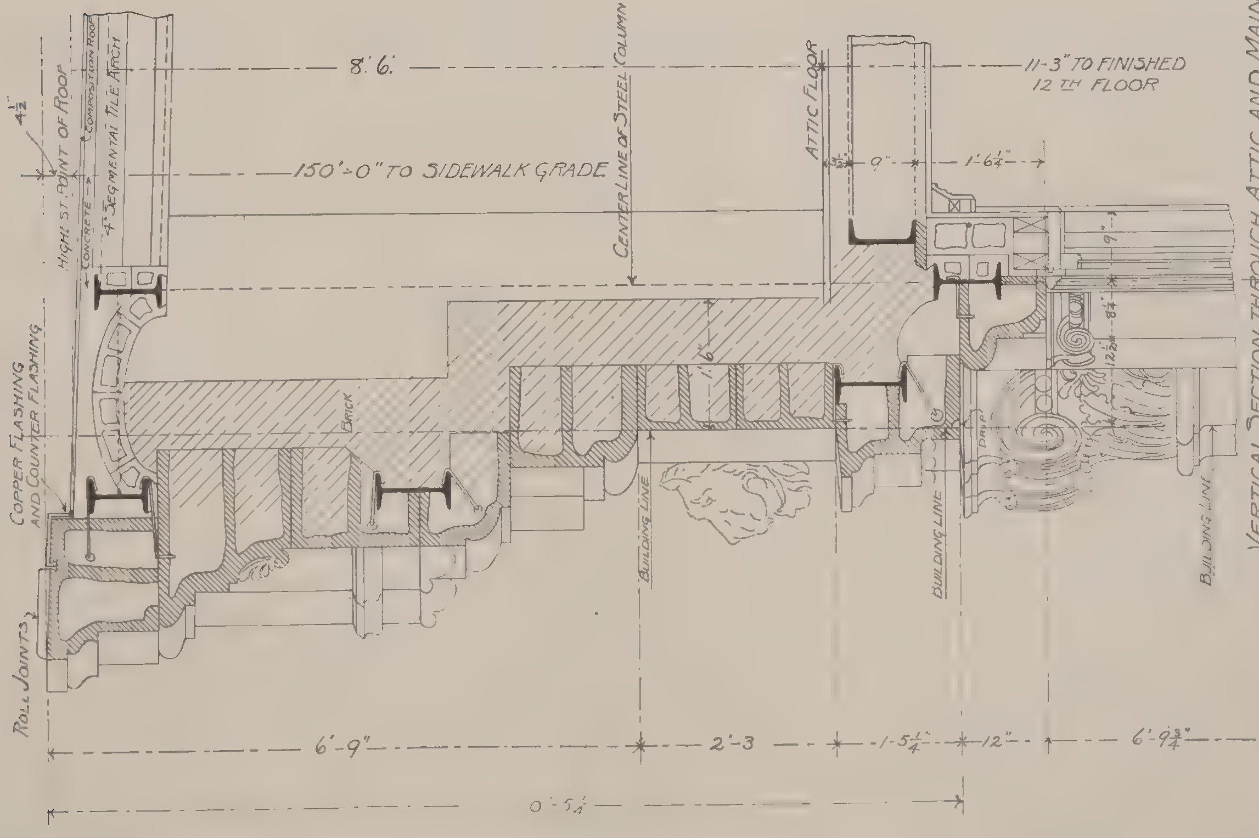


PART ELEVATION
MARQUETTE BUILDING,
CHICAGO.

HOLABIRD & ROCHE, ARCHITECTS.



DETAIL OF MAIN CORNICE WITH CAPITALS AT END BAYS ONLY



VERTICAL SECTION THROUGH ATTIC AND MAIN CORNICE IN END BAYS ONLY

FORT DEARBORN BUILDING

JENNEY & MUNDIE ARCHITECTS

BRICK AND MARBLE IN THE MIDDLE AGES.

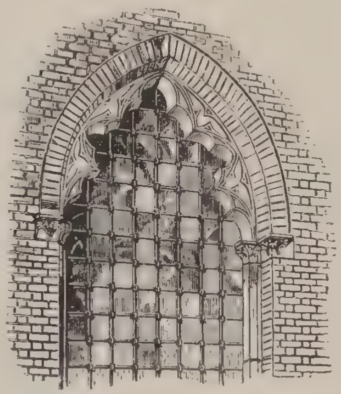
G. Edmund Street.

CHAPTER VIII. — *Continued.*

NEXT in order of merit to SS. Giovanni e Paolo I should place the church of Sta. Maria dell' Orto. This church is in a very bad state, and so far ruinous as to require to be supported in its interior by a forest of shores and scaffold-poles, which makes it quite impossible to get a good idea of the general effect. It has fair-pointed arcades resting upon very classic-looking columns, with capitals of poorly grouped and executed foliage. It is decidedly inferior to the two churches just described, in every respect save the treatment of its west front, which, poor as it is, sins less against all acknowledged rules than do theirs; its character is of a kind of pseudo-pointed, very flat, hard, and awkward. The cornice, with the open Italian pinnacles above it, over the central portion, is better in its effect than the singular row of niches which stands in lieu of cornice for the ends of the aisles; but it is worth while, nevertheless, to observe how simple is the design of these niches, taken separately, and how far this simplicity and the genuine beauty of their cusping and arching go towards redeeming the want of taste which is shown in the choice of their location. The doorway and rose window in the west front are of red and white marble, and in the side windows the tracery and monials are of white marble, and the jambs alternately red and white. The rest of the wall is brick, but has been plastered and washed with pink. The windows at the end of the aisles are remarkable for transoms of tracery supported upon two heights of delicate marble shafts, and entirely independent of the glazing which is fixed in frames within them. This kind of arrangement, incongruous and unsatisfactory as it is here, is worth recollecting, as being suggestive of an obvious opening for the use of traceried windows in domestic work; and it is a plan of most frequent occurrence in the best Italian ecclesiastical architecture. Many of the windows of Sta. Anastasia at Verona are constructed in this way, showing on the outside elaborately cusped and pierced plates of stone, against which, on the inside, the glazing is fixed, surrounded only with a plain circle of stone.

San Stefano is another really striking Gothic church. Its interior, notwithstanding the gaudy red damask with which the Venetians here and elsewhere delight to clothe the columns of their churches, is very fine and unlike what is common in the north of Europe. The dimensions are very large. The nave is about forty-eight feet wide, and the whole length about one hundred and seventy feet. There are a cloister and a chapter-house north of the nave, and a campanile detached at some distance to the east. The arcades of six pointed arches dividing the nave from either aisle are very light and supported on delicate marble columns, whose capitals, with square abaci and foliage of classical character, hardly look like Gothic work. The masonry and mouldings of the arches are not arranged in a succession of orders, as is the case in almost all good pointed work, but have a broad, plain soffeit, with a small and shallow moulding at the edge, finished with a dentil or billet ornament, which, originally used by the architect of St. Mark's in order to form the lines of constructional stone work within which his encrusted marbles were held, was afterwards, down to the very decline of pointed architecture, used everywhere in Venice — not only in its original position, but, as at San Stefano, in place of a label round the arch. Its effect is much like that of the English dog-tooth ornament — a succession of sharp, hard lights and shades, useful as giving value and force to a very small piece of stone work, and therefore exceedingly valuable when used as it is at St. Mark's, and equally contemptible, I am bound to say, when used, as it is in later work at Venice, simply as an ornament; for this it is not and cannot be, as it is the result of no skill or taste on the part of the workman, but just such an enrichment as might be rather better done by machine than by hand. The roof of the nave is a painted timber roof, boarded in a series of cusped lines on the under side of the constructional framework, so as to hide it. I must not forget to add that the interior of San Stefano requires to be held together by iron tires in every direction — a sin to which, in Italy, the eye soon has to become accustomed.

The whole of the exterior is very carefully executed in brick, the moulded work being well done, though very late in date and not good in effect. The western doorway is of a favorite Venetian type. It is square-headed, enriched with mouldings and carving, and above it is an arched canopy with pinnacles on each side with an ogee arched label carrying enormous crockets. The finial is a three-quarter figure, and an angel occupies the spandrel between the arch and the label. Above the door is a large circular window, unadorned with tracery or filling-in of any kind. The window from the east end of the church, of which I give an engraving, is a very characteristic example, of great width, and utterly unlike any example out of Venice.



WINDOW. SAN STEFANO.

Perhaps the very worst traceries in Venice — which is saying a good deal — are in the windows of the apse here, where the traceried arches of the head are repeated over the transom, but inverted and standing on their points. More worthy of admiration is a fine tomb corbelled out from the cloister wall to Andreas Contarina, "*MCCCLVII. Dux creatus MCCCLXXXII. In cœlum sublatus*"; the arched bridge under the choir (which is carried over a canal) should also be noted, as well as the very fine campanile, which, though not boasting of any Gothic detail, is full of the spirit which made the earlier campanili so effective. But if we wish to see the best campanile in Venice, I think we must go back to the Rialto, and there, not far from the Grand Canal, we shall see in that of San Giacomo a perfectly fine example.[1] It is almost entirely of brick, and the fine long lines of its arcades give a great effect of height, whilst the details are all good and quite Gothic in their character.

The other churches in Venice are of less importance than those which I have described, but the number of remains, of which only too many are desecrated, is very large. The Accademia has attached to it the desecrated church of the convent of La Carità. This has three parallel aisles ended with apses, the usual traceries and cornices, and the unusual (I am glad to say) feature of three western gables with arched outlines [2] filled in with much small tracery in brick and terra-cotta. Another desecrated church near this,— that of San Gregorio,— is more interesting. It is of the same general design as La Carità, and, like it, is built of yellowish bricks. The window traceries are of white marble. The most interesting feature here is the cloister, entered by a remarkable doorway from the Grand Canal. The doorway is square-headed, with an ogee trefoiled archway or window on either side, and a sitting figure of a bishop under a slight canopy over the doorway. The cloister has five bays on each side, divided by columns which rest on a marble and brick base, and carry a wooden framework enriched with very good mouldings.

Another desecrated church is that "dei Servi," which has a fine lofty brick front with a large rose window.

In the Campo Sta. Zaccaria is a portal much like that of San

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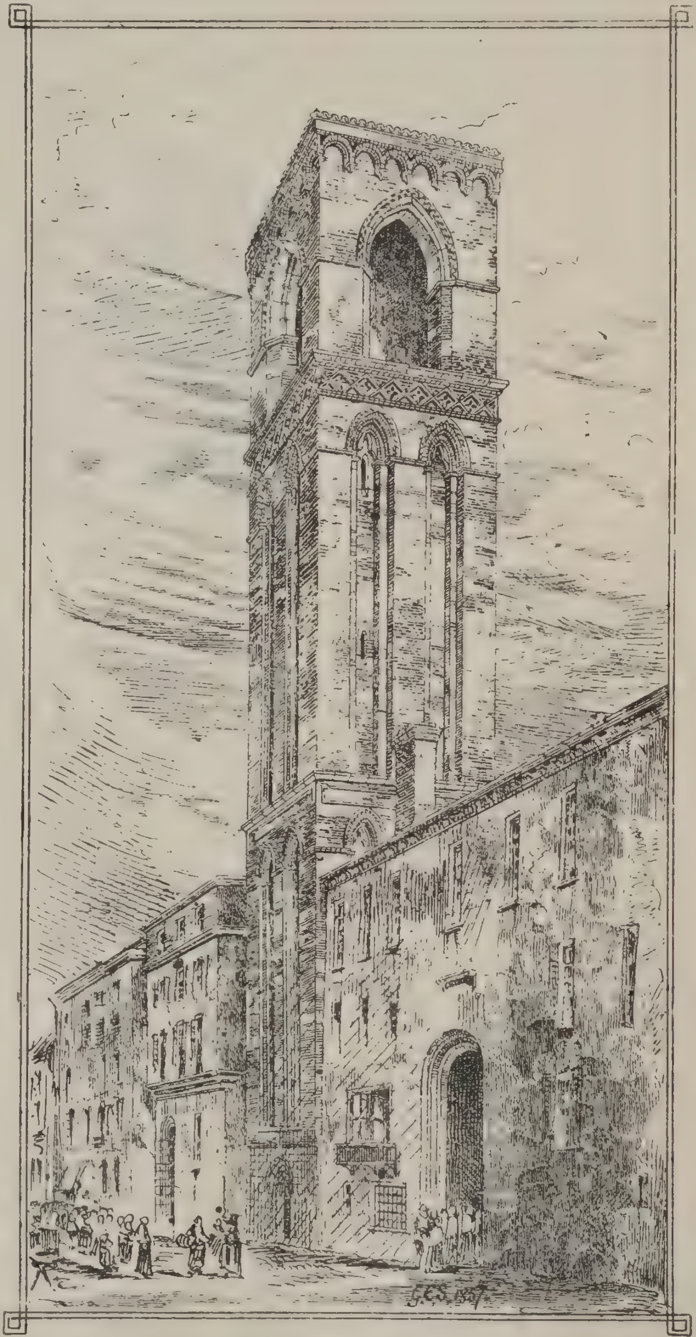
[1] I refer here to San Giacomo del Rialto. Its neighbor, San Giacomo del Olio, has also a brick campanile, but of inferior merit.

[2] A view in the *Nuremberg Chronicle* shows these three gables just as they now are.

Stefano, save that it has in the tympanum a good figure of the Blessed Virgin with our Lord, with a saint on each side — the two Saint Johns, I think. The Virgin is seated on a Gothic throne, carved in very low relief, and the whole composition is decidedly fine; comparing it with the doorway at Mazzorbo, I should say this must be a work of A. D. 1380. The church of Sta. Zaccaria is an early Renaissance building, with many of its arches pointed. It has an aisle and chapels round the choir, an unusual plan in Venice, but otherwise it has no interest.

The church of l'Abbazia has some fair detail in its cornices, with pinnacles at its west end of the same type as those in the Madonna dell' Orto, and has poor ogee-headed pointed windows; near it is another of the canopied doorways, — the gate of the Corte Vecchia, — with an outer arched canopy, within which, under an ogee-shaped label, stands the Blessed Virgin with our Lord in an aureole on her breast. Two saints stand at her side, and groups of little figures kneel at her feet, whilst from the upper finial our Lord gives His blessing. This bears the date of 1505.



SAN GIACOMO DEL RIALTO.

I think I have now said enough about these late Gothic churches. I have never been able to interest myself much about them. The work of which they are specimens is so exceedingly poor, cold, and distasteful to me that I feel much inclined when I attempt to sketch them to give up ecclesiology in despair. The truth is that, St. Mark's excepted — and of course it is a very wonderful exception — the churches of Venice do not come up to the expectations of any one who has ever experienced the delight of visiting the churches of much smaller cities in France, Germany, and England. True, indeed, there are much interest and a great breadth and dignity about the general effect of such a church as the Frari; but for all those lovely points of detail which in every direction amaze us by the art they display and the rich array of beauty with which they clothe the walls of northern cathedrals, here is there no kind of equivalent.

When I had thoroughly come to this conclusion, and settled in my own mind by repeated inspection that my judgment was not harsh or unfair, I confess I felt a weight off my mind. I was now free to indulge myself to the full in the search for what Venice really has in greater abundance, perhaps, than any other city in Christendom,— remains, namely, of mediæval domestic work. Nothing can be conceived more delightful than such a search. You seldom go a hundred yards — often it is much less — without coming upon some remains, or, perhaps, some nearly perfect example, of an old Venetian palace; and then, with the gondola fastened to one of the great posts which line all the canals, the well-satisfied gondolier lying stretched on his back behind the awning, your friends laughing and talking within its dark recess, you sit most luxuriously, and make your notes and sketches with a degree of quiet comfort which is not a little conducive to accurate and careful sketching and to diligence in its pursuit.

Venetian palaces divide themselves naturally into two great classes,— the Byzantine and the Gothic; and it surprised me very much to find remains so perfect and so extensive of the former class even on the banks of the Grand Canal itself, where change has been ever so frequent and so rife. Indeed, it is singular that nearly all the Byzantine palaces are situated on its banks.

Of these palaces, certainly the most striking by far are the Ca' Loredan, the Ca' Farsetti, and the Fondaco de' Turchi. They all agree singularly in the general idea of their design, and consist of a grand scheme of arcading over the entire front. Divided, generally, into two stories in height, they are again divided in a marked manner in width into a center and wings. This division is effected solely by a great difference in the spans of the arches forming the arcades, which in the wings are much narrower than in the central division. In the upper arcade the spaces between the columns, and, indeed, the whole arrangement, are often studiously unlike those in the lower range; but, at the same time, there is so very much similarity in the detail of the whole that this variety, far from being perceived as an irregularity or a fault, does in truth just suffice to give force and vitality to what might otherwise appear to be monotonous and too often repeated, and recalls to mind not a little the very similar kind of difference between the upper and lower order of shafts already described in the west front of St. Mark's.

(*To be continued.*)

AMERICAN ENAMELED BRICK.

THE almost universal use of enameled brick for the inner court construction of the modern office building shows a desire on the part of the owners to give all possible light and cleanliness to their court tenants. This is not a philanthropic move on the part of the owner, — there is money in it. The advantages of a court so lined are made manifest by the great demand for inside offices in buildings, whose white court walls make every inside office, from the highest to the lowest, light and desirable. Until recently we were obliged to depend upon foreign manufacturers for these brick. Now, however, enameled brick of all desirable colors, shapes, and unsurpassed quality are manufactured in our midst.

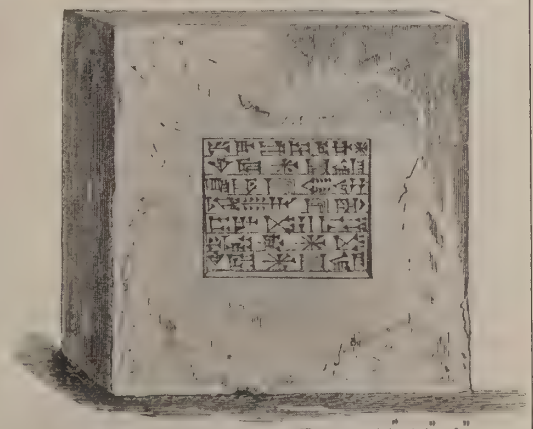
There are nearly a dozen plants scattered through the land where enameled brick are being manufactured with more or less success. The West has probably made more headway in this respect than the East, and many of the sky-scrapers in this city and elsewhere have their courts lined with enameled brick of American manufacture. Although not all the enameled brick made in this country are a success, nevertheless it is gratifying to know that in this industry we are cutting loose from Europe, and it is the determination of the American manufacturers to persistently apply themselves in this regard until perfection is reached.—*Exchange.*

ARCHITECTURAL TERRA-COTTA.

BY THOMAS CUSACK.

IN yielding to a request of the enterprising publishers of THE BRICKBUILDER, to discuss the salient features of Architectural Terra-cotta, the logic of the situation requires that we start at the beginning of that subject. This takes us back over a period of nearly four thousand years, though the earliest attempt to utilize clay may be antediluvian, and is probably coeval with the first appearance of man on this planet. Rude vessels of baked clay rank among the infantile efforts of the human race. They were suggested by man's first necessity, then as now the prolific mother of all his inventions. The works of the primitive potter are as old as that of the grave-digger, and, like the houses that he builds, they, too, last until doomsday. The existing relics themselves show that clay has been resorted to by every known, and some otherwise unknown races of mankind, ever since the grandsons of Noah said one to another, "Let us make brick, and burn them thoroughly." It will be seen that the advisability of *burning them thoroughly* was recognized at a very early date, and if the translators of Genesis had been practical men, as well as scholars, they would have italicized that most essential part of the specification. This the present writer has, with all deference, and at this late day, taken the liberty of doing on their behalf.

These people were, in this respect, at least, wise in their generation, and if they failed in their desire to establish a short road to heaven the intention was good and commendable, and the attempt quite as feasible as that made by some of their descendants. At any rate, they *did* succeed in erecting the first and most notable of all "skyscrapers." Bountiful nature had already placed the material at their feet, and as one may infer, pretty well soaked by the waters of the deluge. As the prehistoric clayworker became more expert in its use, it soon began to fall into shape, "like clay in the hands of the potter," thus furnishing a simile for dexterous manipulation that has done duty throughout all intervening ages.



BABYLONIAN BRICK 14"×14"×4".

The potter's wheel used by the Egyptians, so simple, yet so perfect for its purpose, has survived the revolutions which time and change have wrought in all other mechanical arts, and it remains to-day the same in all material particulars. Indeed, it has been aptly remarked that, should a "thrower" start into life from among the mummies, a temporary confusion of tongues, ancient and modern, would be about the only drawback to his receiving remunerative employment in Staffordshire or Trenton.

The facility with which clay could be fashioned into shape led to its being used for an endless variety of purposes. The funeral urns, statuettes, inscribed tablets, and, above all, the polygonal cylinders of the Assyrians, with cuniform characters made readable by Rawlinson and Layard, are the most tangible landmarks which we have of those ancient times and peoples. They supply not the missing, but the connecting link between ourselves and a very remote ancestry. These forerunners of the fictile art range all the way from votive offerings and emblems of worship, of war, and of triumph to bacchanalian cups and the humbler but more necessary ones of domestic use. The priceless specimens of archaic pottery and terra-cottas to be seen in the British Museum, as in that at South Kensington and the Paris Louvre, etc., proclaim their own indisputable version of ancient history. To come nearer home, the growing collections with which we recently refreshed our memory in the Metropolitan Museum of Art have a peculiar fascination for every thinking person whose mental retrospect is not abridged by the things of yesterday. It is therefore to the museums that we go, enriched as they have been by recent discoveries, rather than to the libraries, when in quest of indubitable facts and the earliest of all data concerning mundane affairs. It was on tablets of soft clay that the state papers, public records, and commercial transactions of the Assyrians were written, and rendered indelible by firing. A portion of what may have been the circulating library of Nebuchadnezzar is now on the shelves of the British Museum, in the form of brick tablets as perfect as when first made, and, though but few, even among scholars, are able to decipher them in the vernacular, as George Smith was in the act of doing when he died at Koyunjik, yet these same leaves of ancient history are legible to all of us in a still wider sense. The inscriptions are said to confirm the writings of Herodotus and to correspond with the Biblical account of the deluge and of the destruction of Jerusalem, when "the Assyrian came down like a wolf on the fold." One thing we do know; these, in common with similar antique relics of a buried past, bear the manual impress of their makers, and irresistibly call to mind the existence of men and of races long since extinct, taking our thoughts back through the ages, until lost in infinity. Yes, there they are to-day; having withstood the inexorable tests of time and of climatic change for periods varying from two to four thousand years! Mute, but

PELEUS AND THETIS. BRIT. MUSEUM.

AZTEC IN HIS FUNERAL OUTFIT.

none the less unanswerable witnesses these to the practical indestructibility of burned clay.

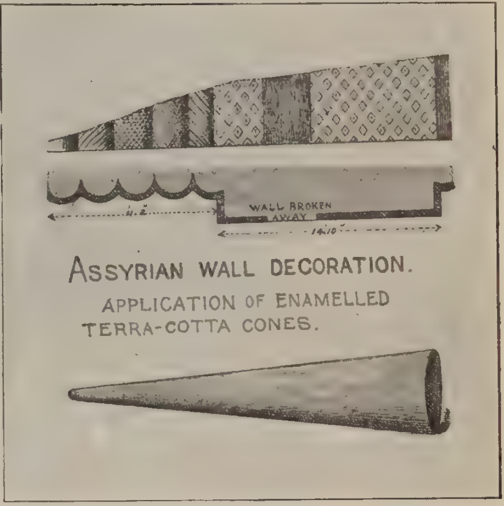
The aborigines of this country, unlike the composite race that has succeeded them (Figaro says "Britonized Indians"), were a little behind their brethren of the East in the esthetic use of clay. The Mound-Builders, however, cooked their food and carried their water in native pottery, made from the same material as they had used "to stop the holes to keep the wind away." The Aztec and Peruvian potters, if we may judge of them by such portions of their work as have survived, were at least fertile in the creation of forms at once curious and grotesque. Failing as artists, according to Grecian or Etruscan standards, they seem to have taken their revenge as caricaturists, all unconscious that in this they were setting an example that would be observed by their successors long centuries after them. The Petiche collection (Metn. Museum) contains two whistles, each about eight inches long, made in terra-cotta, and in the same case may be seen the Mexican idea of model and mould making. Two Aztec tiles about 2′0″ x 2′0″ x 3″ with a dragon ornament in relief, of most forbidding aspect, may have been part of a frieze to some of those wonderful stone structures of which Prescot and Stephens have written, and which were forest-covered ruins, unknown to the natives themselves, long before the arrival of Cortez. The calumet was made of burnt clay, however little it may have been used as a "pipe of peace." And when these fierce tribesmen got ready to return to mother earth they had jars made of burnt clay, with close-fitting lids, large enough for their interment with sufficient room left for some of their worldly goods and chattels, which, contrary to a seemingly mistaken dictum of our own time, they *did* manage to take along with them. The Greeks also produced urns of liberal dimensions, for it will be remembered that it was in an earthenware tub that Diogenes made his domicile and received visitors, one of them being no less a person than Alexander himself.

"IF I WERE NOT ALEXANDER THEN I WOULD BE DIOGENES"

The sun-dried bricks used in the thick walls of Babylon became comparatively hard in that dry Eastern climate, and were cemented together with bitumen. Burned and vitrified bricks were used in the more important structures where space became a consideration. These were laid in what seems to have been lime mortar, so adhesive that travelers and explorers agree in speaking of the difficulty experienced in separating one block from another. Moulded forms alternating with plain surfaces show that the Babylonian builders were not insensible to the value of light and shade. Not satisfied with monochrome, however, they devised a method of applying color. Terra-cotta cones were made and enameled in brilliant colors on the base, which was about three and a half inches in diameter. These cones were inserted in the unburnt clay during progress of building, giving an inexhaustible variety of diaper and zigzag patterns, recalling the lozenge and chefron of a Norman doorway. We have here the earliest known instance of ceramic art, as applied to wall decoration. The revival of architectural color enamels in England and the more recent attempts to introduce them in America will receive due attention under the head of faience in a succeeding chapter.

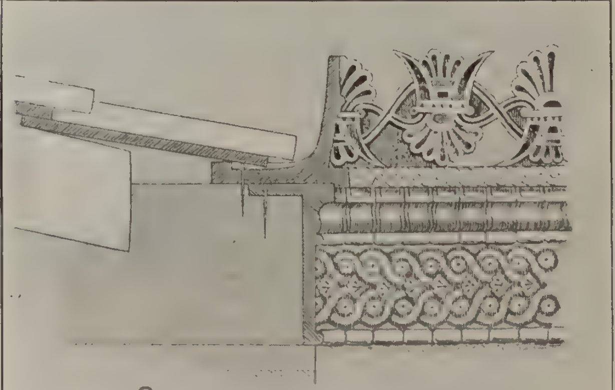
The Greeks, notwithstanding the abundance of their building stones, and the consequent monolithic character of their architecture, resorted to terra-cotta for reliefs and sculptured ornament. They used it for friezes and for the pierced lotus leaf enrichment of their cornices, in a way that actually seems to have suggested its application in some recent instances that we could mention in modern practice.

The Romans introduced the art of brick making into the British Isles more than two thousand years ago, traces of which still exist in the Abbey Church of St. Albans, and many interesting remains are treasured up in the British Museum. An ancient furnace and some Roman tiles were dug up a few years ago in Staffordshire. Here is the center of modern English pottery; though the art seems to have dwindled and disappeared during the dark ages, yet to-day, as a learned writer has pointed out, "the potter's wheel revolves over the potter's grave." This is no mere coincident. The clays that are used there now for the commoner classes of goods are from the same beds that attracted the more industriously inclined followers of Julius Cæsar, soon after that enterprising gentleman said, "*Veni, vidi, vici.*"



ASSYRIAN WALL DECORATION.
APPLICATION OF ENAMELLED TERRA-COTTA CONES.

The Romans continued the use of terra-cotta for friezes and enrichments, even to the extent of Corinthian capitals, and applied it to a much greater variety of purposes than the Greeks had done. Of the Roman arch, to those who have the advantage of Mr. Dillon's translation, and the not less admirable reproductions of Choisy's plates, in current issues of THE BRICKBUILDER, nothing farther need be said. If they did not invent it, they certainly made most extensive and excellent use of it, and have left behind them enduring examples of its varied construction. It was in itself the outcome of a desire to use blocks of smaller section in the spanning of openings than the stone lintels employed by the Greeks, and in which they were restricted to the length and carrying capacity of the stones. The arch enabled them to span much wider openings, without any stones whatever, and by adopting suitable ground plans to enclose areas of enormous extent, which the Greeks would have had to leave uncovered. With the general introduction of this system of building, it became largely a question of brick production, and with the increased demand for brick of all kinds that had been thoroughly burned, the whole process of their manufacture improved, until it reached a higher degree of perfection than had ever before been attained. A style of brick commonly used by the Romans has been



GREEK TERRA-COTTA CORNICE.

revived in the long, thin, "Pompeian" brick now so popular in the New World. And in it, when we want to credit a man with the highest qualities of sturdiness and integrity, we compress the whole vocabulary of eulogium into the simple and direct saying, "*He's a brick*."

The celebrated hyperbole of Augustus, that he had "found Rome of brick and had left it of marble," was a doubtful boast, even if it had been true. At best, it was in most cases but a veneer, and often enough a *stucco imitation* of a veneer. This saying, no doubt, served its purpose as a figure of speech, but, like many other flowers of rhetoric, not confined to the country or age of Cicero, neither it *nor* the marble has stood the test so well as the bricks have. The arch of Augustus was erected at Rimini, to commemorate his reign, and incidentally to recognize his restoration of the Flaminian Way. The triumphal car and statue of himself placed on top mouldered away, and had been replaced, sometime during the Middle Ages, by a parapet built of the despised brick! A recent photograph shows that, while the stone entablature has crumbled, and the volutes have dropped off all the capitals, and the attached columns show signs of ultimate annihilation, the embattled parapet of brick, though the most exposed part of the structure, stands weather-beaten and hoary with age, but every brick in perfect condition. A fitting memorial this, surely, to the Roman brickmakers, at the expense of a Roman emperor. It but needs a little pointing up of the joints by a friendly hand that would not disturb the tufts of grass with which this remarkable monument has by nature been made venerable.

The Pantheon has withstood the vicissitudes of time better than any similar building of equal antiquity. It was there before the wise men from the East came to Jerusalem saying, "Where is he that is born King of the Jews," and it is there yet, despite the rapacity of successive rulers and the irreverent hands of the despoiler. Its walls are of brick, backed up with concrete, covered and indeed strengthened by a dome of the same material. For a third of their height they were at one time cased on the outside with the choicest marble from Greece, the other two thirds being covered with a stucco composed of pulverized marble, said to have been as durable as the marble itself. Around the eaves ran a modillion cornice and another of less projection in line with the original pediment. These were perhaps in marble, but more probably in travertine stone. This outward finish must have appeared very beautiful about nineteen hundred years ago, but where is it now? Why, dissolved into its original elements, carbonate of lime. The fine brickwork of the composite walls of the rotunda, with relieving arches, presumably to span the great niches of the interior, is no longer hidden from view by the sham finish of which Augustus should have been ashamed. They stand up to-day, sound and secure, after a lapse of two thousand years, in their uncompromising grandeur, as if in resentment of the slight which, by implication, Cæsar Octavianus and his friend Agrippa had put upon so serviceable a material.

It is often our privilege, and always a pleasure, to offer suggestions to architects on special methods of terra-cotta construction, but we were born too late to be of any service to Augustus. This we regard as matter for regret. That casing and cornicing should have been done in light gray terra-cotta, *thoroughly burned*, and vitrified on exposed surfaces. The combination would have been honest, the appearance beautiful, and the result imperishable. The enormous advantage — unique, though too often lost sight of — its open chambers at the back, would have enabled the brickwork and concrete to be incorporated into the cells of every block and grouted full with pozzoland, in a way that is impossible with stone or marble. Had this been done with the same skill and thoroughness displayed in the construction of the dome, who will say that the terra-cotta would not have been there to-day, disputing the honors, in point of durability, with the bronze doors, and threatening to outlast the granite columns of the restored portico.

(*To be continued.*)

SEE program for another competition announced on page 116.

SURFACE AND COLOR TREATMENT OF TERRA-COTTA.

PAPER READ BEFORE THE CHICAGO ARCHITECTURAL CLUB BY MR. WM. D. GATES.

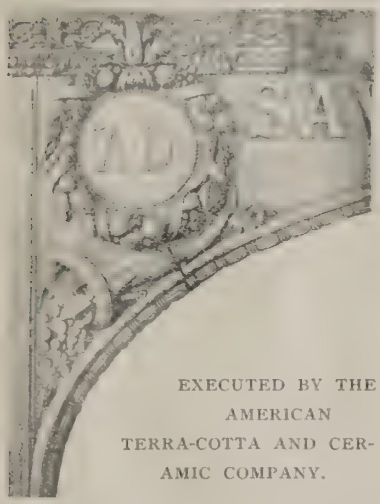
EXECUTED IN TERRA-COTTA BY THE AMERICAN TERRA-COTTA AND CERAMIC COMPANY.

ON a recent trip, I regaled myself one evening at a barnstorming event in a southern city, and it chanced that I journeyed the next day in the immediate company of the band of actors I had seen the evening before. All through the long, hot, and dusty ride, as I sat over a flat wheel turning on a rough track, I was, in the absence of any other occupation, compelled to study my fellow passengers for relief. I viewed the very evident fat coarseness of the hero of the night before. I noted the haughty queen, now shorn of her tinsel and hauteur and on a common level, dickering with the train boy for an apple. (What a pity Mother Eve had not bargained thus and thereby saved us.) But especially as I sat in the seat immediately behind the fair-haired heroine, and saw that her very abundant golden hair had evidently gone in the trunk with the other regalia, and saw that no sane man would be at all justified in undergoing hardship and danger in her behalf, and, finally, as she wearily turned her head and I noted a total absence of the flashing eye and blooming cheek that had thrilled the hero the evening before, as I noted the flabby skin with strong promise of a struggling beard, I was forcibly reminded of the subject of my recently promised paper before you, gentlemen, "Surface and Color Treatment." So I pulled myself together, looked away from the heroine, and looked out of the window. Out across the bay I looked over an expanse of water fringed on the opposite side with pines. The white sails of two schooners cut sharply against the piny horizon, while the water of the bay glistened in the sunshine and rolled under a fair sailing breeze.

I said to myself, the foreground of that picture is formed wholly of waves and the waves are all alike. Then, looking more carefully, I said, no, not alike. They are similar; one has a speck of foam, another none. One is arched here, another depressed there. They are very much of a kind, but are all different. One only has to think of an artist attempting to paint waves with a rubber stamp to realize what such repetition would effect. Then my eye rested on the fringe of trees and I said, all are alike, one pine and a thousand pines. Then second thought said, not so; one is big, another little; one bends this way, another that. Into each detail of leaf and bark, of branch and root you may trace similitude, but not duplication. A difference everywhere, and yet a harmony all pervading. So with the sails, they have their differences, and even those black specks against the sails which we know to be men, and you know how they differ.

So I am led to conclude that Nature does not duplicate. That she uses harmony, but likes endless variety, and that all these little differences fit in and make a complete and harmonious whole. In the surfaces that Nature gives us to study, the treatment indicates individuality and endless diversity, but no departure from harmony. This will warrant much study on our part, particularly those of us who are using material capable of being readily changed.

Let us look a moment at what has been the history of surface treatment in architecture. At a very early period, rough, loose boulders were undoubtedly used piled up into a very rude wall, very likely in the first instances to close the entrance to some cave, and most likely laid up entirely without reference to appearance. But taste would not be long in showing itself, and soon some one would begin to acquire a reputation as being specially handy at this work, and he would begin to place the best-looking surface outward, so that there would be noticeable improvement, and, finally, rivalry between different artists in this line would lead to the inevitable result of crude tools, shaping into more convenient form, and then to the further extent of dressing the surface of the stone and bringing it into more perfect condition for the purpose required. So rectangular forms would succeed roughly rounded ones, and tooled surfaces would succeed the gravel and water worn work of the glacial epoch. Then come the requirements of size, as to what is handy and convenient to produce and handle, as well as what kind of tooling will give the best effect, taking the character of the stone into account; some stones lending themselves to rough treatment and others again requiring the very finest treatment of the rubbing bed to bring out their special beauties. Now the question naturally arises as to just what we manufacturers have been doing in a practical way in our own chosen lines for the improvement, upbuilding, and elevating of our own vocations. The stone cutter, having long experience and a limited range, has pretty well exhausted his field; but how is it with the clay worker? The brickmaker, trying honestly to excel, has been laboring for as perfect a brick as possible, for sharp angles, straight lines, smooth surface, and even color, and in obtaining these he has achieved much success. Is this, however, all there is for him to do? Is this, indeed, the sum of and the height of his art, or is he possibly in a measure wasting his talent and time in a wrong direction? He seems certainly to have been satisfied in his own mind that these were the real requirements, but is it not just possible that he has been blind to or ignorant of some of the things you architects may have wanted? Is it not possible that you and he have not been close enough together; may not have fully understood each other's needs, as well as just what effects were wanted, and what ends were required? He is using a material which lends itself to change in a most marvelous fashion; which changes its form at a touch and yet holds the very imprint of the artist's thumb for centuries. A material that changes shape and size in the manufacture, for every clay, you know, shrinks in drying and again in burning, thus giving opportunity for warpage and consequent distortion — small, indeed, perhaps — of the plain surface, but, yet, which must be carefully considered. And is this not possibly fitted for a field of its own in which it shall not be an imitator, but shall stand original and unsurpassed? Nature has been very chary of polished surfaces, showing them only in mirror-like water surfaces, and had we not better confine them to glass, glaze, and the marble and granite from the rubbing bed?



EXECUTED BY THE AMERICAN TERRA-COTTA AND CERAMIC COMPANY.

I cannot but think that we manufacturers have not kept sufficiently in touch with you, the active, practical designers. We should see more of you and talk more with you as to what you want to use, what effects you would like to produce; knowing these things, happily we may be able to produce what you want. Then, too, in our experimental work, we should be quick to detect a promising effect and not slow to show it to you and ask your opinion, for thus some of our accidents might bear fruit. But I fear we have been too much shut up with these ideals of shape of surface of some particular and very even color, that our predecessors have had, and we have been feeling our way, as it were, instead of pushing and originating. A brickmaker once, laboring honestly all the while to make as smooth a brick as possible with the sharpest possible edges and corners, had made up and piled in his yard to dry a lot of brick of which he was very proud, and which he considered as perfect bricks, having very sharp edges and corners, being especially smooth, and promising to be of a very even color. A rain storm coming up, however, dashed his hopes and, despite all his efforts to prevent it, washed off the exposed edges of these bricks, as well as all the sharp corners. The skies cleared and the bricks dried, only it happened that, instead of throwing them back into the pug mill, as had often been done before, this time they needed them to fill out the kiln for burning, and so they were put in and burned. When the kiln was opened these bricks, being without the well-known requirements of smooth, sharp edges, smooth surface, and even color, were dumped out of the way where it was hoped no one would see them, to be possibly used sometime for filling a back wall or some other ignoble, obscure use. There they lay, forgotten, until one day an architect, visiting the place on other business, was spending a little spare time looking around, noting the especial requirements of the material in its manufacture, that he might plan his work the more consistently and aptly in the use of this material, and thus work in harmony with the manufacturer, with the contractor, and with the workmen, and so all work to the common end of producing the best building possible, which is always our common purpose. On the round of examination and exploration the eye of the architect happened to spy out this pile of spoiled bricks, and he started to make a closer examination, against the protest of the manufacturer, who apologized for the rubbish, and explained that it was an accident, and tried to lead him away to a pile of perfect bricks. He knew these were uneven, all covered over with projecting warts and recesses, and of a very uneven color, even showing little stones, and generally having most of the defects he had been trying to avoid. But the architect would not be led. He hovered about that pile of rubbish, and, looking at one brick after another, his quick eye detected effects to be wrought by that chance material which were far beyond those of the smooth brick that were the manufacturer's delight. The result was that the pile of rubbish, gladly sold for a low price, formed the front for a handsome and striking house on a prominent city boulevard, and a new style of brick had been formed and made by accident and against — not by — the efforts of the manufacturer. To be sure, the architect knew a good thing when he saw it, but it was only the chance visit that brought it to his notice. The edifice built was like the vista of pines and waves over the bay, no two leaves alike, no two twigs alike, no two bricks alike, yet all similar and all in harmony.

Another manufacturer had a clay that bothered him, in that it was not pure; there were chunks of iron ore in it, and, try as best he could, he could not get them out, and his bricks, instead of coming from the kiln of the smooth, even color so much desired, came with ugly black blotches. But the enterprising architect found his way, luckily, into his establishment, and the result was the discovery and use of the speckled brick, and another new and rarely beautiful effect was added to the resources of the architect and to the line of clay manufacture, and a line that promises more effects for the future than possibly any other one branch.

Why must the manufacturer — the maker — the producer — wait for the accident of rain to roughen the surface of his ware so that by that roughened surface the finished wall may have light and shade — high light and deep shadow — in pleasing variety? And why, when accident has happily shown him this very pleasant effect, and shown him, also, how quickly his brother in the architectural line seizes and uses this novel finish, — why, then, should the manufacturer wait, like Charles Lamb's Chinaman, for the house to burn down to give him roast pig? Should the manufacturer wait for another accident or go on and profit by the idea and make more without accident, but with firm intent? Should he not go even further and exercise all his talent for the production of other and further pleasing effects outside and beyond the one shown by the accident? If the one chance roughening produced an enhanced effect by its distribution of light and shadow, is it not probable, at least, that other and pleasing effects in light and shadow surface effects can be studied out and wrought by intelligent effort? And why not in color, too? It is true, color is a very dangerous element and will bear no trifling, but once strike the right key and the chord is rich and harmonious.

Walls have been built, and the fingers of time have worn them — the elements have tinted them. The showers and the tempests, the fogs and the soot all have contributed to toning and blending, to softening or brightening the picture. Vegetable or lichen growth has attached, and slight but beautiful color effects have been wrought, and we are amazed, and generation succeeding generation has admired and wondered. If we want a like effect, must we wait for generations later to enjoy it, or can we take the lesson from nature, and tone our wall with the slightest possible speckling of green or gray without being charged with making artificial antiquities? It is not imitation. It is emulation. Would not the same reasons prevent our decorating the interior walls? Must a terra-cotta house be red or else be said to be an imitation of stone, or can the parties in interest take advantage of the research and learning, of the thinking that has been done, and of the advancement made by reason of accident and by thought as well, and maybe say boldly, I like such and such tints (without being told that unless he can find them in stone they are not proper), and that he can go even further and say, I like a mass color, or I prefer a spotted effect? Perhaps his fancy is born of raindrops on the veranda floor; possibly from a distant vista of green lawn dotted with dandelions or white clover; no matter how formed, it is worthy of consideration, and augurs well for effect if studied faithfully and carefully.

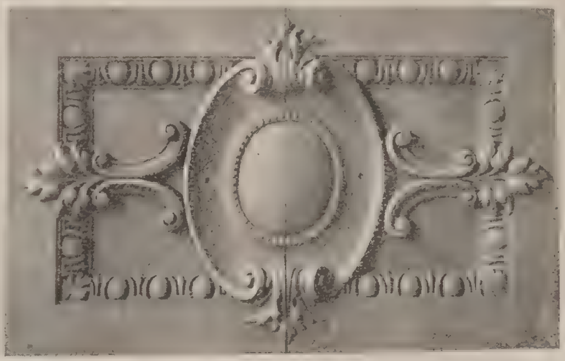
In clay there are certainly very many very promising possibilities in the line of a roughened surface texture by means of which very pleasing effects of light and shade may be obtained, and which is a very promising field for the exploration and research of the architect and manufacturer. While in the same material the possible color effects are practically without limit. This I firmly believe to be a field into which we have only taken the first few steps, a panorama of which we have only had a few fleeting glimpses, but of whose real diversified beauties we have as yet no proper conception, and yet I feel that we shall yet see many of these vistas and enjoy their beauties.

Why should we not learn from these chance happenings, and, noting these beauties, try to analyze them and make combinations that will be equally pleasing to the eye — not aping antiquity, and trying to make a wall appear different from what it really is; but, learning that a little fleck of color here or shade there adds to the general effect, why not use it and enjoy the beauty of the wall in our own generation, and then let posterity enjoy it as well?

We manufacturers have recognized this, I fear, to too limited an extent. Whatever chance we have given you, our architectural brothers, has been made good use of by you, quickly and intelligently, but it seems that these chances have arisen more from our accidents than as the result of our earnest research.

All that I have said relative to surface and color treatment, whether of brick or stone, applies equally to terra-cotta. While terra-cotta is a material that excels in duplication, still, by a proper surface treatment this duplication will not appear as such, and in color treatment in many cases absolute variety as well as entire harmony may be obtained. Terra-cotta lends itself to surface treatment so readily, however, that in absolutely original and individual effects there is no limit, and the field of its application is all the time broadening. Human nature is, however, so variable that none of us can tell what to expect in the line of criticism or praise. The general principles, broad and sound principles of art, will always command attention and admiration. Still, when the average citizen begins to try to analyze them, there is trouble, for, while he may recognize a good effect, he may not be able to explain the why and wherefore.

I recall a building in which I particularly prided myself on having carried out this idea of individuality to the extent of having no two pieces absolutely alike, and yet obtaining a color effect that had been universally admired. One party who was a great admirer of the effect, and had praised it and recommended it for use in other places, added to his commendation, "But I would want all the blocks alike." He knew a good thing when he saw it, and yet was not able to analyze and find wherein the effect existed, but wanted to cut out the very thing that produced the effect he admired. Since then, whenever I get on high stilts over praise for an achievement, I keep a weather eye for a soft spot to fall on when some one knocks out the stilts.



EXECUTED BY THE AMERICAN TERRA-COTTA AND CARAMIC COMPANY.

The lesson from all this seems plain and pertinent, that the relationship should be closer. That we should cultivate the expression of the needs and requirements, and then give intelligent scope to our efforts to produce the things required. Nor should the manufacturer be at all backward about showing the architect any new chance acquisition he may happen on, as well as the result of his efforts to produce an effect which he was seeking. To you, architects, the lesson seems to indicate more freedom in expressing your wants and requirements, as well as more talks with the manufacturer and more frequent visits to the manufactory.

Let us all labor together, then, for effects in surface and color that shall lead to the erection of a line of noble edifices that shall stand as beautiful and enduring monuments, both to your greatness as designers and originators and to our skill as manufacturers. Monuments which, standing in beauty and majesty, shall remain as a joy and pride to this, as well as to succeeding generations.

ALTHOUGH the Chicago building ordinances restrict the height of buildings to about ten stories, yet permits which were rushed out before the present ordinances went into effect seem to hold good indefinitely, and, even though nothing but hasty sketch plans were submitted to obtain those permits, now, years after the permits were taken out, plans are made and buildings are erected at the pleasure of the owners. Several sixteen-story buildings are yet likely to be built under these old permits. But not to regard this as surprising or unjust, certain owners have had the assumption to claim the right to transfer a permit to an entirely different piece of property, and build a sixteen-story building on ground for which no permit has been issued.

Fire-proofing Department.

Constructed in the Interest of Building Construction to Prevent Loss by Fire.

FIRE-PROOF FLOOR ARCHES.

(*Continued.*)

BY GEORGE HILL, C. E.

PUBLISHED TESTS. — CONTINUED.

THE Columbian Fire-Proofing Company write, calling my attention to several points in the last instalment, which they believe do them an injustice. They claim that, by the use of rolled steel bars and by a complete knowledge of the material, they are building a very much better arch than the tests would show. They say: * * "The tests to which you refer were made at the very outset of our career and were made under the most severe conditions possible, as you will see by looking over the data. The concrete was green, the loads imposed were directly on the floor, clear of beams and without the strength imparted by floor strips, filling, and wooden floor, and the bars used were prepared by riveting the ribs on, as we had no special rolls at that time. * * * * Moreover, these floors were only calculated to carry the lightest loads, such as for apartment houses, etc., and the tests for heavier floors were made later on." * *

They claim that at the present time they have made tests which demonstrate beyond question the strength of their arch, and that, by the proper spacing of the steel ribs, a floor can be proportioned for carrying any load, there being no surplus or waste of strength in the making, and they further claim that they find a ready market for their product.

At the present time they are building several floors in New York, and promise to submit several sections of these to test. As a consequence, we shall defer further comment until these tests have been made.

In support, however, of the claims which they make, they quote certain tests herein below given: —

No. 41. A section 4′ 0″ wide, 7′ 5½″ span, containing 30 square feet, which carried an equally distributed load of 24,312 pounds or 810 pounds per square foot. Details as to deflection, character of material used for the loading, and sizes of bars are not given.

No. 42. A section calculated to carry 200 pounds per square foot, loaded with 810 pounds per square foot, no deflection, and then tested with a drop load.

No. 43. A test arch which carried 600 pounds per square foot, with a drop weight of 300 pounds from a height of six feet without failure.

Concrete and Twisted Iron. In connection with this subject, attention is called to the article appearing in the March and April numbers of THE BRICKBUILDER, in the concrete department, describing the methods adopted by Mr. Ransome, in his concrete-iron construction. This has already been sufficiently treated. It is mentioned here simply in order to make the record entirely complete. Other tests of different methods of concrete-iron construction will be referred to later on.

Metropolitan Tests. (Catalogue of company issued in June, 1895.) This system was formerly known as the Manhattan System, and is described as follows: Cables, each composed of two galvanized wires twisted together, usually using No. 12, are placed from 1″ to 1½″ apart, varying the distances according to the load which is to be carried. These cables are held by hooks or clips, which grasp the top flange of the beam and are made of No. 2 wire. They pass under bars in the center of the span, which give them a deflection of from 2½″ to 3½″, varying with the span between the beams and the load to be carried, 3½″ being the amount used for a 6′ 0″ span. Forms or centers are placed underneath these cables, and a composition made principally of plaster of paris and wood chips is poured on. As plaster of paris sets very quickly, the resulting floor is sufficiently strong to be used at once under loads, with a surface uniform and level with the top of the beams. Where a panel ceiling is used, permitting the beams to show, wire netting is stretched over the beams, and the same composition poured around them, fire-proofing the beam. Where a flush ceiling is required bars are placed on the bottom flanges of the beams and wire netting stretched over this, and a floor plate of about 1½″ in thickness is made by moulding on the material; this gives a covering to the bottom flange of the beam of 1″. The top flange of the beam is protected by covering it with some of the plastering material, and the finished slab is as shown on Fig. 15.

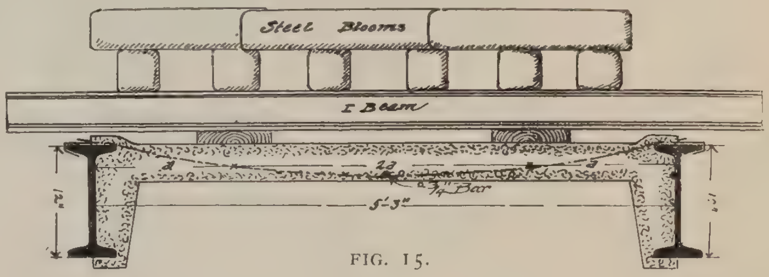


FIG. 15.

This ceiling plate is entirely independent of the floor, and consequently, when the floor plate deflects under a load, the ceiling plate remains intact. It also gives a void, which may be used for ventilation or for the purpose of carrying pipes around through the floor; this latter purpose, of course, being practically defeated by the necessity for framing into the girders at the end of the spaces. In regard to the fire-proof qualities of this material, it is said that when it is exposed to flame for a long time the composition is rotted to a depth of from 3/16″ to ⅝″, the remainder being unaffected. If water is thrown upon it, the mass does not crack or fly. When made thoroughly wet, as would happen from water thrown into the building during the fire, the composition is not destroyed. During prolonged test, plates made of this material will remain cool on the surface not exposed to the flame. In the case of one test, snow remained unmelted on the upper surface of the plate, while the under surface was exposed to continuous fire for four and one half hours.

It is well known that plaster of paris, however, when subjected to heat has the sulphate changed to a sulphide, which is readily removed by water; as a consequence, alternations of flame and water on the same surface would probably lead to a disintegration of the surface, and if this should happen at the point where the covering of material is but ¾″ thick, as it is immediately under the bars in the center of the span, the arch would be liable to attack and failure, because the wires, by reason of their small mass, would very quickly heat up and draw out. This danger occurs, however, only in the event of the omission of the ceiling plate, and, as under all circumstances, except in warehouses where light is not especially necessary, the ceiling plate should be applied, the danger of failure is perhaps not very great. The ceiling plate, being supported by the wire netting, is, according to tests which have been made, almost impossible to burn through, and the consequence is that it would probably afford an efficient fire protection. Inasmuch, however, as none of the tests quoted by the Metropolitan Company describe how the water was applied — that is, whether there were alternations of water and fire, or fire on one side and water on the opposite — we do not know precisely what would occur. It may be that the unknown parts of the composition would have the effect of rendering both the wood and the plaster of paris proof against flame; this can only be determined by tests made for this especial purpose. Comparative tests were made by the company for the purpose of showing the value of the arch for this form of floor, as compared with the flat hollow-tile arches, and these tests are given in the tables following, being tests numbered from 44 to 58, both inclusive.

RESULTS OF TESTS OF FLAT HOLLOW-TILE ARCHES.

Number.	Distance between beams, center to center.	Clear distance between webs.	Depth of block.	Length of section tested.	Area tested in square feet.	Total load applied in pounds.	Load per square foot, in pounds.	REMARKS.
44	5′ 6 3/16″	5′ 5⅞″	9¾″	4′ 3¼″	23.445	4,536	193.5	The thrust of arch kicked out lower flanges of beams.
45	5′ 6 3/16″	5′ 5⅞″	9¾″	4′ 4½″	24.02	20,140	839	Failed suddenly from breaking of horizontal webs of blocks next to skewbacks.
46	5′ 7 5/16″	5′ 7″	9¾″	2′ 0″	11.17	5,670	507	Failed suddenly from breaking of horizontal webs of blocks next to skewbacks.
47	5′ 7 5/16″	5′ 7″	9¾″	2′ 0″	11.17	3,330	298	Failed suddenly from breaking of horizontal webs of blocks next to skewbacks.
48	4′ 10 5/16″	4′ 10″	10″	1′ 0¾″	5.135	2,900	564	Failed suddenly from breaking of horizontal webs of blocks next to skewbacks.
49	5′ 0 1/16″	4′ 11¾″	10″	4′ 5½″	22.2	8,599	387	Failed suddenly from breaking of horizontal webs of blocks next to skewbacks.
50[1]	5′ 2 15/16″	5′ 2⅝″	6″	4′ 5″	23.05	9,492	411	Failed suddenly from breaking of skewbacks and blocks next to skewbacks.

In test 44 tie-rods were placed through the centers of the webs of the beams, as is usual in practice; this was a test, therefore, of the ordinary manner of arranging tie-rods, rather than a test of the efficiency of the arch blocks.

In tests 45, 46, and 47 the arches were built between beams firmly held against lateral movement.

The arches were built from selected blocks and the work done with great care; they were laid in Portland cement mortar, composed of one part cement to two parts of good, clean, sharp sand. Except in tests 47, 48, and 49, the tops of the arches were leveled up with one inch of the Portland cement mortar.

In tests 47 and 49 no mortar was placed on top of arch, except to give the planks (load was applied same as in Metropolitan test, Fig. 15) even and horizontal bearings.

In tesf 44 the load consisted of brick applied as shown in Fig. 16. In tests 45, 46, 47, 49, and 50 the load consisted of steel blooms applied as shown in Fig. 15. In test 47 the load was stone blocks applied on planks as in Fig. 15.

[1] TEST 50.— Instead of flat hollow tile, this section was built of six-inch hollow segmental arch blocks, with a rise of six inches; sufficient filling was put on top of the arch to give the planks on which the load rested even and horizontal bearings.

RESULTS OF TESTS OF METROPOLIAN FLOORS.

Number.	Distance between beams, center to center.	Clear distance between flanges.	Length of section tested.	Area tested, in square feet.	Total load applied, in pounds.	Load, per square foot, in pounds.	REMARKS.
51	6′ 10″	5′ 5″	2′ 0″	10.832	5,395	498	Did not fail.
52	4′ 7″	4′ 2″	1′ 0″	4.166	5,630	1,351	Did not fail.
53	6′ 2″	5′ 7″	1′ 0″	5.583	6,040	1,081	Did not fail.
54.	5′ 5″	5′ 0″	9½″	3.958	7,600	1,920	Two cables on one side broke. The others were unbroken.
55	5′ 6″	5′ 0½″	2′ 6″	12.605	15,146	1,202	See note.
56	4′ 6″	4′ 0½″	2′ 6″	10.105	15,682	1,551	Failed by the breaking of cables on one side.
57	4′ 6″	4′ 0½″	5′ 0½″	20.38	29,314	1,438	Adjoining sections, being without load, lifted. No wires were broken.
58	3′ 9″	3′ 3½″	2′ 5″	8.229	18.950	2,302	Adjoining sections, being without load, lifted. No wires were broken.

Tests 51, 52, and 53 were made on sections taken at random in buildings where floors were being put in under contract and were not tested to destruction.

In test 55 the adjoining sections, being without load, commenced to lift; the section was not tested to complete destruction.

These tests are open to criticism as incomplete in data, and therefore cannot be properly investigated or fully interpreted. This is to be regretted, because but little is shown by the tests above quoted of what ought to be known positively of a new combination, and especially because, as I have before remarked, the combination of steel wire, representing the strongest form in which the metal can be used to take up the tension existing in the floor construction, with a fire-proofing material to take up the compression, fire-proof, and preserve the metal as well, is one that cannot be too highly commended on theoretical grounds, as it very closely approximates perfection. Under such circumstances, the more we can learn of the material, the more tests we can make of it, the sooner will we discover its weak points and eliminate them, and the greater the use to which it can be applied.

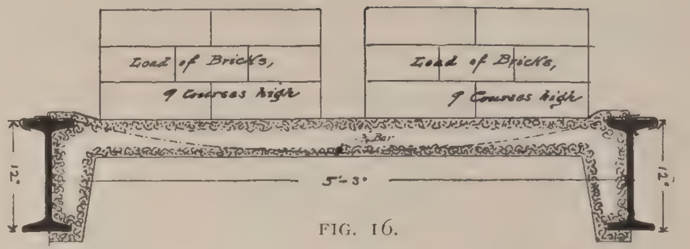


FIG. 16.

The advantages claimed for this system are: —

First. Its superior fire-proofing qualities.

Second. Its great strength and the manner in which it transmits the load to the beams, girders, columns, and walls.

Third. Its lightness, making its use of great economy, and reducing the loads on the foundations, in ordinary conditions, fully twenty-five per cent.

Fourth. That by its use it is possible to complete a building, so far as the fire-proofing is concerned, sooner than by using other fire-proofing systems.

Concerning those claims it is perhaps well to state: —

First. That the fire-proofing qualities may be admitted under certain conditions, but not entirely conceded as yet.

Second. The question of strength is by no means demonstrated. The method of applying the load in the tests which are relied on for proof is one which is objectionable, because it represents conditions very rare in actual practice, and because precisely what the strains are which exist in the mass by reason of the application of the load in this peculiar manner no one knows. Had the load been applied eccentrically, there is no doubt but that the arch would have acted very differently; had it been applied centrally in the center of the span, there would have been a direct test of the material, and its effect would probably have been to very much decrease the amount of the loads which were carried; had it been uniformly distributed by building up a crib of planks, which would be in a measure flexible, and applying the load to them so as to secure a true distribution, we don't know what the result would have been, but it is probable that no greater loads would have been carried than those herein noted.

The desirability of more complete tests is shown by noting that in the series of tests given for hollow-tile arches the greatest load carried was 20,000 pounds, while these arches were built, as is stated, from selected blocks. The writer in some of his tests, which will be subsequently given, has put loads in excess of 55,000 pounds on a single arch of about the same span and less depth, thus showing the variation in conditions and the great variation in results which follow therefrom. *Second.* Concerning the point of the manner of this floor's transmission of the load to the supports, it need only be said that where the floor is designed according to well-known engineering principles there is practically no difference between the method of transmission of the load for the various systems, since the floor-plate, itself in conjunction with the beams which form the abutments, takes up all of the strains, transmitting simply the vertical loads to the girders, columns, or walls.

Third. Its lightness. In support of this claim it is stated that * * * "When ready for the plaster underneath and the floor above, the weight is about 24 pounds per square foot, which is 40 to 70 pounds per square foot less than that of most other systems when leveled up in concrete ready for the floor. In the case of a modern building, 100 by 120 feet, twenty stories high, the saving in dead load would be about 60 pounds per square foot, making a total saving, exclusive of the saving in metal work, of * * * 7,700 tons. By using this system for a building of this size, not only would there be a saving of the metal work necessary to carry 7,700 net tons by the beams and girders to the columns, and by the columns to the foundations, but the foundation would have to carry less weight by 7,700 net tons plus the saving in weight of the metal work."

To one who is fully posted, this statement is a *reductio ad absurdam*, but as this may not be evident to all of our readers, we will take it up in detail, thus: First, consider that in any building, and particularly in an office building, the only kind which would be carried up twenty-stories in height, some area must be allowed for the space occupied by walls and courts; this would reduce the area considered and consequently the saving in weight by at least twenty per cent. Ordinarily an office building has about thirty per cent. of area occupied in this manner. Second. In considering what improvement can be effected by any new device, it should be compared at least with good current practice, and at the present time the weight of fire-proof floor arches ready for the finished floors, when the same are properly designed, is for arches ten inches in thickness, or arches for use with ten-inch beams, which corresponds with good conditions of column spacing, about 41 pounds per square foot. Now, in this case a flush ceiling is provided, which is an absolute necessity for good lighting conditions, such as would be required in the building under consideration. Therefore the corresponding weight for the Metropolitan floor, including the ceiling plate, would be about 34 pounds per square foot. These considerations, then, leave the savings on this very large building but 672 tons, and I believe that this probably fairly represents what should be obtained in the present state of the art. I do believe, however, that should complete tests prove that the material is reliable under commercial conditions, and possessed of sufficient compressive strength, that other forms can be devised that will materially save in weight, and that there is less opportunity for stupid designing in this material to needlessly increase the weight than exists with the use of the hollow tile. Of course I do not deny that there are many buildings in which the floor weights may approximate the amount given in the above quotation, but I do deny that they represent the best that can be done under the circumstances, or that they represent even fair practice.

Fourth. So far as the completion of the building is concerned, if Portland Cement is used with a proper design of hollow-tile arch, very much less water enters into the composition of the floor and it is consequently unnecessary to wait so long for it to dry out, and repeated tests have clearly demonstrated that these floors will carry heavy loads, even when laid up dry.

It would therefore seem as if it were quite feasible to design a hollow-tile floor so as to give a working platform ready for use just as soon as any panel of blocks had been set in position and the centers removed.

(*To be continued.*)

SLOW BURNING BUILDINGS.

PAPER READ BEFORE THE NATIONAL ASSOCIATION OF FIRE ENGINEERS AT MONTREAL.

BY WILLIAM MCDEVITT,

Inspector of Philadelphia Fire Patrol.

AT the last meeting of this association action was taken regarding the experience with and effect of fires in buildings erected on the so-called "slow burning" plan. Some criticisms have been made on the opinions expressed here by those favoring this method of construction, and, as this plan is being applied to buildings used for mercantile and light manufacturing purposes, such diversity of opinion forcibly illustrates the necessity of cooperation between architects and our fire officials. The latter want is being made more apparent and deserves more notice from this association than has been given it when viewing the responsibilities which are being cast upon fire officials in the inevitable destruction by fire through faulty architecture.

In the varied methods and combinations which have and are daily being adopted in building construction with a view of protection from fire, architects experienced in the difficulties met in fire fighting, in devising plans for a building, often introduce features which, in event of a fire occurring within it, may develop a disadvantage, tending either towards its destruction or acting as a barrier to the firemen. Such has been the experience and results in many instances with fires with the present plan of so-called "slow burning" mill construction, owing particularly to the feature of isolated floors. Instances may have occurred to substantiate the claims made for this plan of construction, owing, perhaps, to the aid of automatic or other extinguishing apparatus at hand, but in the absence of these auxiliaries, and the frequent occurrence of their failure when called upon, leaves the construction alone to be considered.

The term "slow burning," as applied to heavy timber construction, originates, no doubt, from the fact that with the burning of a small bulk of heavy timber the consumption appears to be slow, as less smoke and flame is given off than that from lighter kindling. But it must be remembered that in the burning of heavy, dry timber combustion is more perfect, the gases do not escape in the form of smoke, and the heat given off is far more intense than that from an equal weight of lighter wood. With a fire extending over a flat space of heavy timber, such as that of a ceiling of a large room, the intense heat accumulated over the entire plain will cause a rapid destruction of the inner part of the space burning.

The practice of isolating floors with a view of confining a fire in any kind of a construction, regardless of area or nature of contents, is not without its disadvantage and possible dangerous effect, causing, during a fire, a lateral spread of the heat, which, in the present period of lofty buildings facing each other on narrrow streets, is conducive to a conflagration. No better illustration of this latter danger can be seen than that afforded by a fire with headway in a structure built on the "slow burning" plan, with isolated floors.

In Philadelphia four or five buildings of this character have been burned in different sections of the city, and the extraordinary rapidity with which they were destroyed and the communicating of fire to surrounding buildings caused considerable comment, including criticisms on the efforts of the fire department.

Being personally present at the burning of four of these structures, the similarity in condition and results that followed in each instance was remarkable. It could be observed that the solid ceilings acted as a spreader for the fire at the beginning, distributing the fire over the broad surface of exposed timber, causing a spread of the fire and smoke, with no outlet but the doors and windows for the heat, which was ejected out with such force that where the fire originated either in the basement or lower floors the heat prevented any approach of attack, and in a few minutes burned the hose leading along the street and set fire to the buildings across streets sixty feet in width, causing in one instance a loss of nearly $400,000. One of the mills burned was fortunately located on an open lot; in this case it was impossible to approach within a hundred feet of the burning structure. It may be well to state that none of the buildings referred to were equipped with automatic sprinklers, but in two cases it is doubtful if such protection would have had any effect, owing to the highly inflammable character of the contents. Each were equipped with stand-pipe, water supply, and hose connections. In three instances the fire originated during working hours, and, notwithstanding prompt discovery, the rapid spread of the smoke and heat prevented the use of the appliances at hand.

With fires in buildings of ordinary construction, the elevator shafts, stairways, and other openings through floors, offer to a certain extent, an upward escape of smoke and heat. And with ordinary conditions, timely discovery, and prompt notice, burning buildings are accessible, and the daily experience proves that fires are either confined to a portion of the building or within the building itself. This opportune advantage, together with the forcing of ventilation in the upper part of a burning building (a method often resorted to by fire officials), is a feature that architects should consider and provide for in devising plans for fire-proofing with isolated floors, as a large area containing abundance of fuel and allowed to burn will wreck most constructions of the present day.

Experience seems to prove that the present plan of so-called "slow burning" mill construction, with isolated floors, is a deception as titled, and the erection or presence of buildings of such construction in thickly built quarters is conducive to an extensive conflagration in event of a fire occurring within them.

Mortars and Concrete Department.

Devoted to Advanced Methods of using Cements and Limes in Building Construction.

AMERICAN CEMENT.

BY URIAH CUMMINGS.

CHAPTER V.

A TREATISE on cements would hardly be complete without allusion to those cementing agencies which, although they can hardly be classed as hydraulic, as that term is now understood, were used in mortars and concretes centuries ago, and many specimens of which are still in a good state of preservation.

We refer to carbonate of lime and sulphate of lime, each of these being mixed with sand, clay, gravel, and finely broken stone. The latter having been used above, while the former was used both above and below ground. It is quite irreconcilable with our modern ideas as to the causes of the hardening of mortars, yet the fact remains that carbonate of lime has been made into a mortar by admixture with clay, sharp sand, and gravel, and after three thousand years is found to be as hard as a rock.

A paper by Dr. Wallace read before the Mechanics Institution, Glasgow, so completely covers this subject as to render a literal quotation desirable.

On Ancient Mortars. By William Wallace, Ph. D., F. R. S. E., F. C. S. From the *London Chemical News, No. 281.*

Having, by the kindness of William Clarke, Esq., C. E., who has recently returned from the East, been supplied with specimens of mortars and plasters from well-known ancient buildings in Egypt, Greece, Italy, and the Island of Cyprus, I have submitted a number of them to analysis, with the object of determining several points of interest. The ages of the mortars vary from about sixteen thousand to upwards of three thousand years, thus dating back to the most ancient historical periods. I propose in the present notice to give the results of the analysis of such of the specimens as I have examined.

Mortar of the Great Pyramid.— Two specimens of mortar from the Pyramid of Cheops were examined, one being from the interior, and the other from the outside of the structure. That from the interior was from the great chamber or the passage leading to it. Both specimens present the same appearance,— that of a mixture of plaster of a slight pinkish color, with crystalized selenite or gypsum. They do not appear to contain any sand, the silicic acid being evidently in combination with alumina as clay. Part of the selenite was probably burnt, and the result mixed up with burnt lime, ground chalk, or marl, and coarsely ground selenite. The latter would act the part of sand in our mortars, *i. e.*, prevent undue contraction in drying. The quantity of water is almost exactly what is required to form the ordinary hydrate of sulphate of lime with two equivalents of water. The mortar is easily reduced to fragments, but possesses a moderate degree of tenacity. Prof. C. Piazzi Smyth, who is at present making explorations in the pyramid, and to whom I have communicated the results of my analysis, has informed me that large quantities of gypsum and alabaster are found in its vicinity; and that some enormous slabs of alabaster or selenite have been discovered lining the walls of a large tomb recently opened. The material of which the pyramid itself is constructed being limestone, there is no difficulty in accounting for the presence of the lime.

	INTERIOR.	EXTERIOR.
Sulphate of lime, hydrated	81.50[1]	82.89[1]
Carbonate of lime (CO_2 calculated)	9.47	9.80
Carbonate of Magnesia (do.)	.59	.79
Oxide of iron	.25	.21
Alumina	2.41	3.00
Silicic acid	5.30	4.30
	99.52	100.99

Ancient Phœnician Mortars from Cyprus.— Two specimens were obtained from Cyprus. The first is from the ruins of a temple near Larnaca, the highest stone of which at present remaining is five feet below the level of the ground, and the lowest about eighteen feet. Mr. Clarke supposes this to be the most ancient mortar in existence, and it certainly is one of the best I have ever seen. It is exceedingly hard and firm, and appears to have been made of a mixture of burnt lime, sharp sand, and gravel, some of the fragments being about half an inch diameter. On solution in hydrochloric acid, it gave a small quantity of soluble silica, amounting to .52 per cent.

The other specimen from Cyprus is a cement used for joining water pipes. These pipes were found near Larnaca, ten feet below the surface of the ground, and bear evidence of extreme antiquity; they are of red clay, about eleven inches in diameter, and are connected by spigot and faucet joints, the intervening spaces being filled with the cement, and afterwards coated with a black substance which was found to be bitumen. This mortar or cement is very hard and perfectly white in color. It will be observed that in both of these Phœnician mortars the lime is almost completely carbonated.

	TEMPLE.	CEMENT.
Lime	26.40	51.58
Magnesia	.97	.70
Sulphuric acid	.21	.82
Carbonic acid	20.23	40.60
Sesquioxide of iron	.99	—
Alumina	21.6	.40
Silicic acid and fine sand	16.20	.96
Coarse sand	3.37	—
Small stones	28.63	—
Organic matter	.56	.24
Water	.54	3.09
	100.26	98.39

Ancient Greek Mortars.— The first specimen is taken from a part of the Pnyx, the platform from which Demosthenes and Pericles delivered many of their orations. It has been long exposed to the action of the weather, is very hard, and of a grayish-white color. The other specimen is plaster from the interior of an ancient temple at Pentelicus, near Athens. It has not been exposed to the weather, the temple being in a cave; it is of a pale cream color, and moderately hard. The analytical results are the following:

	PNYX.	TEMPLE AT PENTELICUS.
Lime	45.70	49.65
Magnesia	1.00	1.09
Sulphuric acid	—	1.04
Carbonic acid	37.00	38.33
Sesquioxide of iron	.92	.82
Alumina	2.64	.98
Silicic acid and sand	12.06	3.90
Water	.36	3.07
	99.68	98.88

In the mortar from the Pnyx the carbonic acid is exactly the amount required by the lime and the magnesia, supposing both to be completely carbonated; in that from the temple the carbonating is nearly but not quite complete.

Ancient Roman Mortars.— These differ from those already mentioned in being evidently prepared by mixing with burnt lime, not sand, but puzzuolana, or what is commonly, although improperly, called volcanic ash. Of these, four specimens were examined, but two only of the analysis were completed, owing to deficiency of material. The first in the following table was taken from Adrian's Villa at Tivoli, near Rome; it is a tolerably hard and firm mortar, of a rather dark-gray color.

The second is plaster from the interior of a wall at Herculaneum; it is hard, evidently exposed on one side to the action of hot volcanic mud, and of a red tint. The third specimen is from the roof of the

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[1] Water by actual estimation, 16.66, 17.38.

Latin tombs near Rome, of a pale reddish-brown color. The fourth is a cement or mortar from a mosaic forming the floor of the baths of Caracalla, Rome. All these mortars were hard and firm, and contained an appreciable amount of silicic acid in combination: —

	ADRIAN'S VILLA.	HERCULANEUM.	LATIN TOMBS.	MOSAIC.
Lime	15.30	29.88	19.71	25.19
Magnesia	.30	.25	.71	.90
Potash	1.01	3.40	not estimated.	
Soda	2.12	3.49	not estimated.	
Carbonic acid . . .	11.80	23.80	13.61	17.97
Peroxide of iron	4.92	2.32	1.23	3.67
Alumina	14.70	2.86	16.39	10.64
Silicic acid and sand .	41.10	33.36	36.26	30.24
Organic matter . .	2.28	1.50	—	2.48
Water	5.20	1.00	8.20	5.50
	98.73	101.86		

General Remarks. — These analyses appear to show that the lime in mortars and plasters becomes, in the course of time, completely carbonated, and does not form a combination consisting of $CaO,HO + CaO, Co_2$, a conclusion that has been arrived at by some authorities. They also show that in all cases where the mortar is freely exposed to the weather a certain proportion of alkaline or earthy silicate is formed, which in all probability confers additional hardness, and that those mortars are the hardest which have been long below ground. It is well known to builders that those walls are strongest that are built during a rainy season, and that when mortar dries quickly it becomes crumbly and possesses little binding power. When kept wet for some time, a small proportion of silicate of lime will be formed, which will not only make the mortar itself harder, but will unite it more firmly with the stone. It is curious that the mortar which is probably the most ancient (the specimen from a Phœnician temple) is by far the hardest and firmest; in fact, like a piece of rock. It is a concrete, rather than a mortar, and its excellence seems to indicate that a large-grained sand is best for building purposes, and that even small gravel may, in certain cases, be used with advantage.

(*To be continued.*)

AMERICAN PORTLAND CEMENT.

PAPER READ BEFORE THE MASTER BUILDERS EXCHANGE OF PHILADELPHIA, MAY 28.

BY WM. G. HARTRANFT.

THE remains of great engineering and architectural work in Egypt and parts of Asia and Europe prove that ancient and extinct civilization was familiar with the use of cement. Mr. Henry Reid says: "These remains, of a varied and interesting character, even now show us how much of their stability and permanence is due to the quality of the cementing agents by which the building materials were put together."

The experiments conducted by Mr. John Smeaton in the years 1756 and 1757 for a reliable mortar for building the Eddystone Lighthouse, and the experiments carried on by Dobbs, John, Vicat, St. Ledger, Palsley, and Frost in the early part of this century, and the taking out of patents by Joseph Aspin, of Leeds, Eng., in the year 1824 for the manufacture of what he called "Portland Cement" show that the men of the eighteenth century did not possess as much knowledge of hydraulic cement as the men of ancient times.

Mr. Aspin's Portland Cement, so called because the artificial stone made from it resembled the Portland Building Stone of England, was manufactured under the following patent: "My method of making a cement or artificial stone for stuccoing buildings, water works, cisterns, or any other purpose to which it may be applicable (and which I call Portland Cement) is as follows: I take a specific quantity of limestone, such as that generally used for making or repairing roads, and I take it from the roads after it is reduced to a puddle, or powder; but if I cannot procure a sufficient quantity of the above from the roads, I obtain the limestone itself and I cause the puddle, or powder, or the limestone, as the case may be, to be calcined. I then take a specific quantity of argillaceous earth or clay and mix them with water to a state approaching impalpability, either by manual labor or machinery. After this proceeding, I put the above mixture into a slip pan for evaporation, either by heat of the sun or by submitting it to the action of fire or steam conveyed in flue pipes under or near the pan, until the water is entirely evaporated. Then I break up said mixture into suitable lumps and calcine them into a furnace similar to a lime-kiln, until the carbonic acid is entirely expelled. The mixture so calcined is to be ground, beaten, or rolled to a fine powder, and is then in a fit state for making cement or artificial stone. This powder is to be mixed with sufficient quantity of water to bring it into the consistency of mortar and thus applied to the purposes wanted."

That this process of late years has not always been honestly followed in England will be seen by a letter which I will read, which was sent out by the attorneys of one of the largest cement manufacturers in England to other manufacturers.

LONDON, Oct. 26, 1894.

DEAR SIRS: — We are desired to call your attention to the following circumstances, seriously affecting the trade in which you are engaged. It is becoming notorious that several manufacturers of English Portland Cement are largely adulterating their manufacture by the mixture of Kentish Ragstone, other stone, furnace or oven ashes, disused or exhausted fire-bricks, or other inert material, and so bringing disrepute on the good name English Portland Cement has hitherto borne in comparison for quality with cement of foreign manufacture. Such practices are so detrimental to the best interests of the cement trade, both by the discredit which is thereby attached to English manufactures and the unfair competition in prices thereby rendered possible, that it is now proposed to form an Association of English Cement Manufacturers for the purpose of dealing with and, if possible, putting a stop to a practice so unprincipled and disreputable and so calculated to perpetrate an injury to the trade. We are instructed to inquire if you would be willing to join an Association of Cement Manufacturers for this purpose, and, if so, we shall be glad to hear your views on the subject, and to know if you would attend a meeting presently to be convened. We are, gentlemen,

Your obedient servants,
RENSHAW, KEKEWICK & SMITH.

A detailed report can be found of this meeting, which ended without accomplishing any result, in the issue of Nov. 23, 1894, of the *London Fairplay*. The German Association of Cement Manufacturers require that Portland Cement shall be made by calcining an intimate mixture of calcareous and argillaceous materials as chief ingredients and subsequently grinding the calcined mixture to the fineness of flour.

Mr. David O. Saylor, the pioneer manufacturer of Portland Cement in this country, said: "In order to make Portland Cement, it requires a homogeneous mixture, containing in proper proportions carbonate of lime, alumina, silica, and iron. This mixture must be subjected to a heat sufficiently high to produce a vitrified, dense, and heavy clinker, and afterwards ground to very fine powder. The induration or setting of Portland Cement consists in the formation of a real mineral, of a crystalline rock species, which appear to be analogous to natural zeolites. This fact can be confirmed by miscroscopic examination of a true Portland Cement. The set will be found to consist of translucent and, to some extent even, of transparent crystalline particles of different forms, exactly like those of the zeolites of nature."

It will be seen by the above that the early manufacturers of Portland Cement in England, Germany, and America were of one mind as to the constituents of a good Portland Cement, and with the

American's genius, and the unlimited deposits of the purest cement-making rock found in the world, it is not surprising that American cements are of the best quality.

At the present time the bulk of the English cement is manufactured from chalk, instead of the hard limestone. This chalk is mixed with clay in the proper proportions before burning in a large wash mill, and the slurry is then run off and dried, either by artificial means or sun evaporation. The only difference in the burning now and in Aspin's time is that this dried slurry is now burned to a hard clinker, instead of just expelling the carbonic acid gas. Works were started for the manufacture of Portland Cement in Germany, France, and Belgium soon after the works were established in England. In the former countries it is largely made of an argillaceous limestone or a marl. This material is usually ground and mixed in a dry state, dampening only sufficient to mould into a brick, so as to facilitate the loading of the composition into the kilns.

The Portland Cements of Europe did not begin to find their way to this country until about 1865, and from 1865 to 1870 small quantities were shipped here and sold at from $8.00 to $10.00 per barrel. This large price and the increase in demand for this cement attracted the attention of Mr. David O. Saylor, who was then manufacturing at Coplay, Pa., a light burnt, hydraulic cement, commonly known on this market as Rosendale, and he decided to make a Portland Cement equal to any made in Europe out of the argillaceous limestone found at Coplay, and which in the latter part of the year 1874 he succeeded in doing. Although this was fifty years later than the industry was started in Europe, the American product at once took first place on large engineering work, where great quantities have been used.

Major-General Gilmore, after testing and inspecting the cements at the Centennial Exhibition, said there were thirteen brands of foreign and one American Portland Cement exhibited, and that the American brand[1] stood among the five best specimens. In 1878 Capt. J. B. Eads selected an American Portland Cement with which to build his great work, the "Concrete Mississippi Jetties," using 12,000 barrels alone in this one operation. It is worth noting, while we are reading from time to time in the engineering journals of concrete work in Europe disintegrating under the influence of the salt and waves of the ocean that these concrete jetties at the mouth of the Mississippi River, which have successfully withstood the action of the salt and waves of the Gulf of Mexico, are made of Portland Cement,[1] manufactured within sixty-five miles of Philadelphia. The great concrete docks, which the city of New York has been building for the past eighteen years have been largely made of American Portland Cement.[1]

American Portland Cement was also used largely on the big masonry dams and aqueducts[1] of the Croton Water Supply for New York; in the foundations of the Brooklyn Bridge;[1] in the Hudson River Tunnel;[1] the Niagara Tunnel; in the foundations of the new Manhattan Life Insurance Co.'s Building, New York (twenty stories high); in the new Capitol Building, Albany, N. Y.;[1] in the Concrete Jetties at Sandy Hook[1] and is now being used by the United States Government on the new Post-Office Building at Washington, D. C., and in the concrete sea walls being built at Brooklyn, League Island,[1] and Norfolk Navy Yards. Among the large buildings in Philadelphia built with American Portland Cement are: The Drexel Building, the Drexel Institute, Provident Building, Girard Building, Harrison Block,[1] Pennsylvanian Railroad Station, Philadelphia & Reading Railroad Station,[1] Odd Fellows Temple, Women's Medical College, Bourse Building, and new Hotel Walton. (Last two under construction.)

With such monuments to the durability of American Portland Cement, it is almost inconceivable how an engineer or architect can feel justified in drawing his specifications in a manner so as to exclude the American manufacturers from competing for their work; yet there are many men who have charge of the erection of buildings which in the aggregate consume as much Portland Cement as the large engineering operations who do not permit the American Portland Cement to be used. If this rejection of a native product for one of foreign manufacture was done after a careful comparison of the quality of the two materials, and the native cement found wanting in any good particular possessed by its foreign rival, the American manufacturer would not complain, but such rejections are simply because it has the misfortune to have been made by American labor and out of lime, silica, and alumina found in this country, rather than Europe; as comparisons which have been carried out in a large and impartial manner have proven beyond question that the American Portland Cements, as a class, are equal to the foreign cements.

In proof of this, I will cite a few instances: In the report of the Engineer Commission of the District of Columbia for the year ending June 30, 1893, we find there were seven German, two English, and five American brands of Portland Cement submitted on government work in Washington and carefully tested by the commission. The two cements which proved to be the strongest, when tested neat and with sand mortar and the finest ground, were both American Portland Cements. In the report of the Water Commission of St. Louis for the year ending April, 1894, where 80,000 barrels of Portland Cement were recently used, we find tests on fifteen brands of Portland Cement, carried out for two years, and that among the four best brands was one made in this country. In the annual report of the Director of Public Works of Philadelphia for the year 1893 we find that two of the strongest and finest cements used were American brands. From over 6,000 tests made by the Survey Department of Philadelphia, on cements being supplied to city work during the year 1894, we find that the average strength of the American Portland Cements in neat and sand mortar was in excess of any of the foreign cements. The different foreign cements figuring in these various reports are the best European brands, many of which cost in this market from 25 to 50 cents per barrel more than the American Portlands, although the latter have proven to be so much superior. With these facts and figures in your possession, the American manufacturer asks the builders and contractors of this country to assist in bringing to the attention of the architects and engineers the fact that in using foreign cement they do not get the best quality, and are wasting their clients' money.

In the year 1894 there were nineteen factories in the United States which make about 700,000 barrels of Portland Cement, this amount being but 18 per cent. of what was imported. The largest factories are located in Lehigh County, Pa., in the neighborhood of Coplay. All the factories located in this region make cement under the dry process from an argillaceous limestone. There are several factories in New York State, along the Erie Canal, and in Ohio where marl and clay, or limestone and clay are used. Practically, nine tenths of the Portland Cement manufactured in this country is made in the States of Pennsylvania, New York, and Ohio. Other States where small quantities are manufactured are Texas, Colorado, Dakota, Oregon, California, and the Territory of Utah.

There is plenty of raw material suitable for making the highest grade of Portland Cement in almost every State in the Union, and with the proper encouragement from our architects, engineers, and builders, there is no reason why all the cement needed in this country should not be made at home.

BRICK-DUST MORTAR. — The use of brick-dust mortar as a substitute for hydraulic cement is now recommended on the best Spanish engineering authority, experiments made with mixtures of brick-dust and quicklime showing that blocks of one half inch in thickness, after immersion in water for four months, bore, without crushing, crumbling, or splitting, a pressure of 1,500 pounds per square inch. The use of brick-dust mixed with lime and sand is said to be generally and successfully practised in the Spanish dominions, and is stated to be in all respects superior to the best cement in the construction of culverts, drains, tanks, or cisterns.

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[1] Saylor's Portland Cement.

The Mason Contractors' Department.

Conducted in the Interests of the Builder and the Contractor for Brickwork.

A TALK WITH THE CONTRACTOR.

IN looking over the present condition of the mason builder's business throughout this country, we cannot but notice, however hard we may try not to do so, the general incapacity of the journeyman bricklayer. Nearly every large contractor of brickwork has in his employ some men who are worth all or more than they are paid, some who earn possibly the equivalent of their wages, and some who, no matter how rough the work may be, never earn for their employer as much as their wages, and it is of this latter class that we complain.

They are always behind time, always in the way of better men, never do anything right, cannot carry a corner and keep it plumb, cannot even lay brick on the line without "crowding" it; their window and door jambs resemble stairs, on account of their roughness; they "whitewash" the work, to use a truthful phrase, both outside and in; they strike about half their joints and these are generally only partially filled with mortar; they never have the inside and outside of the wall on the same level, always roll their brick the wrong way so as to leave a "lip" on the under side, put the poorest side of a brick out, cannot turn the simplest arch and have it true; in short, cannot do any piece of work even after it has been laid out for them and do it in a first-class manner. Strange, isn't it, that men who claim to have served a three or four years apprenticeship, have been journeymen for years, and are worthy (?) members of the "union" should be so absolutely lacking, and have the face to expect as much pay as the most skilled mechanics? Right here I want to emphasize what I believe to be one of the greatest drawbacks of unionism as at present conducted. It undoubtedly tends to pull the good men down and bolster the poor ones up, thus putting all on the same level, consequently discouraging a higher standard of labor. Did you ever look at it in that light, brother builders? A man may be worth much more than "union" wages to his employer, but still he must not receive a cent more than the fellow who isn't worth his salt. Why do not the unions adopt a graded system of excellence, and have a man paid according to his worth?

There are many good bricklayers who know what a brick is and how to lay it, but that is about the limit of their knowledge. They understand a plan about as well as the Hebrew language; couldn't lay out a piece of work if their life depended on it. Many mechanics who pretend to be good bricklayers have never served a regular apprenticeship, but have picked up what little they know — and it's often hard to tell what that little is — from observation, and blunder along, trying to palm themselves off as journeymen. Surely, some of them would never stop their journey as far as bricklaying is concerned if contractors would do their duty.

It is a fact to be deplored that so few American boys are learning the mason's trade; but it must be conceded that American boys, as a rule, prefer to stand behind a counter at six dollars a week, where they can keep their hands soft and clean, than to learn a trade, especially that oldest and noblest of all trades, "masonry." What a great mistake they make. In three or four years they could place themselves in a position to earn two or three times as much as can be secured in the same length of time behind desk or counter.

But, alas! "what fools these mortals be."

IN modern building some of the greatest achievements of engineering skill have been carried out chiefly in brickwork, and in some instances to the entire exclusion of stone. This being so, it will not be out of place to consider the essential conditions of what is now universally accepted as being worthy the name of *good brickwork*.

Of the importance and necessity of solidly bedding the bricks and effectually flushing up the interior joints, no one is so fully alive as the practical brickbuilder. Apart from flushing up the brickwork as a means of obtaining the maximum amount of tensile strength, in addition to that obtained by good transverse and longitudinal bonding, to carry the loads to which most walls are subjected, and to provide against the possible lateral movement of any of its parts when the whole is under strain, the question has its sanitary aspect also. The walls of dwelling-houses defectively flushed up are really air filters on a large scale. They are liable to be receptacles of damp, driven in by the storms and induced by the hollow, or partially hollow state of the brickwork, leading up to disease, and in some cases probably fatal consequences.

The old saying that "a wet building makes a dry house" is worthy of all acceptance. Walls built wholly of dry or insufficiently wetted bricks will be found wanting in two chief characteristics of good work, viz., solidity and a firm and binding adhesion of the bricks and mortar. This is nowhere better exemplified, on the one hand, than in old brick footings and walls in situations subjected to the continuous presence of adjacent moisture. Many retaining walls, for instance, supporting an undrained or badly drained bank of non-porous earth, in which case the chemical action set up between the sand grains and the lime has gone on so uninterruptedly that the mortar has crystalized and attained that condition known to practical men as water-bound brickwork. The extreme opposite case is that of building walls with dry bricks in the height of summer. The dust coating the bricks is unremoved, forming a separating medium or layer between the bricks and the mortar, and so preventing adhesion. And where dust is not present the moisture of the mortar is taken up with avidity by the dry bricks that very little or no adhesion is the result, and the mortar by examination when dry is found to be little better than a cake of slightly moistened, compressed dust. On the other hand, the bricks should not be wetted to a degree of saturation, or they will be incapable of absorbing the finer particles of mortar into their bodies, which they should do, forming so many threads binding the bricks and the mortar together. Unless the bricks be well wetted to induce the mortar into the cross joints and wall joint during the operation of flushing up every course, the work should be grouted. But under any conditions and circumstances the bricks should be wetted before use, except in winter or frosty weather, when the air is generally so humid as to reduce the absorbent power of the bricks. It is then advisable to forego the risk of wetting the brick, especially if the work is in exposed situations.

EFFICIENT as many of our workmen have become in after life in the handiwork portion of their craft, it is a fact that many are found uninformed and wholly deficient in the scientific principles and knowledge on which the whole superstructure of their handiwork rests for stability. It cannot but be evident that this condition has been a drawback and an encumbrance to the prosperity of many a competent workman.

In this department of The Brickbuilder we shall endeavor to place before him such useful and practical information that, if properly utilized, will add greatly to his prosperity, and which he should possess to be considered a proficient and reliable mechanic. The writer has found, as a rule, from his own experience as a mechanic, that when the workman has ventured to pass his judgment in regard to the construction and stability of certain kinds of work pertaining to his art, in the presence of those who consider that they have been particularly educated to possess such knowledge, that his opinion, rather than being received with respect by them as being of any reliable authority, was looked upon with rather a contemptuous good humor, and placing the mechanic in rather a ridiculous and humiliating position before those contemplating or erecting an edifice. As a rule, works upon construction are generally written in an abstruse and perplexing manner to the practical mind of the mechanic, and designed more for those who work with the pencil, rather than he who labors with the trowel, and too expensive for him to procure, but THE BRICKBUILDER endeavors to overcome that difficulty by presenting practical information in a plain and intelligent manner. Almost any journeyman, at the rate of wages he receives, can afford to invest $2.50 per year for the practical ideas contained in THE BRICKBUILDER, and contractors would do well to encourage their men to keep abreast of the times in this manner.

THE relations of an architect and the mechanic are so intimately connected with the successful construction of a building, and the foregoing remarks explaining the qualification that should be possessed by the latter are such that his association with the latter in the management of an edifice would be most agreeable. Therefore, every mechanic should take a pride in cultivating and enlightening his mind on the scientific principles of construction; and by so doing he will not leave himself, as is often the case, to the mercy of some picture drawer, whose knowledge of sound and durable construction is of the flimsiest and most clerical nature. R. N. BUELL.

EDITOR BRICKBUILDER:

Dear Sir,— In your May issue appear two very interesting articles on mortar, showing the evils that exist in that very important and frequently neglected material that enters into the construction of a building. As an officer in a company whose business is the manufacture of mortar, it has been my privilege to go into this question to a greater extent than is usually done by a builder or any mechanic. Our plant, which was started about three years ago, turns out daily from two hundred thousand to eight hundred thousand pounds of mortar, for both bricklayers and plasterers, and we find the best lime to use for general purposes is one which contains a considerable amount of magnesia, a pure carbonate not giving the setting qualities desirable. Our lime is received almost daily, from three to ten cars a week, varying with the season. This lime is shipped in box cars and unloaded into bins. We have four slacking machines or revolving pans, into which about twelve bushels of lime are placed and enough water introduced to slack without burning. The pan is started and the lime is kept in motion by a mechanical arrangement consisting of three feet on a perpendicular shaft. When the slacking is complete a plug is removed, and the lime and water carried by a trough through three screens into a well; from this well it is pumped into vats located in the upper floors of the mixing-house. Screening the lime eliminates all core or underburnt limestone, stones, and other foreign matter so injurious to mortar, especially that used by plasterers.

When the lime and water is pumped into the vats it much resembles thick milk, which, after standing three weeks, assumes the consistency of soft cheese. Water is allowed to stand in these vats, which further aids in the slacking of any minute particles that have escaped through the sieves, and also to prevent the air from reaching it.

When mortar is to be made this lime paste is carried to the mixing pans, which are like those used in slacking, with the exception that they have two sets of feet, sharp, clean bar sand is also placed in the pans and the machine thoroughly incorporates the lime and sand into a homogeneous mass, not a streak of lime and a streak of sand, but a material of uniform evenness. As a result of this care, I have tested brickquetts made of machine mortar and have obtained as great a tensile strain as fifty-two pounds to the square inch; in twenty-seven or twenty-eight days, out of three brickquetts broken, I secured forty-eight, fifty-two, and fifty pounds tensile strain. We never allow lime to air slack; neither do we mix the sand with the hot lime and allow it to stand.

Good mortar, like every other good product, cannot be made by ignorant labor, which may or may not be honest, and never produces, exactly, twice the same results.

It has always been most astonishing to think that the very sinews of a building, the mortar which holds it together, is very generally placed in the hands of unskilled and almost unthinking men. It is covered up during the progress of the work, and, should a wall get out of plumb or fall down altogether, the blame is always attached to everything and everybody possible; to the mortar, never.

Before building assumed the proportions that it has during the last decade, work was done more slowly and better, on the average, than it is now, especially in the house-building line. But in the mad rush to become rich, the desire of many is to erect houses, "skinning" wherever possible, covering up poor construction by paint and paper and then disposing of the house for whatever profit is possible, leaving an ignorant and innocent purchaser with a miserable building to repair.

Foundations laid in mud with bricks laid in whitewashed, sand-plastered walls, kept together by highly decorated paper, are seen in every city where municipal legislation does not prevent by punishing the offender. It seems to me that the immense amount of money which is constantly being placed in new buildings would be sufficient cause for the enactment of State laws to make bad building a crime and to fix standards for every material used in the erection of any structure, especially those adapted for dwelling-houses.

Yours respectfully, HENRY LONGCOPE.
Secretary Quaker City Mortar Co.

LEGAL POINTERS.

KNOWLEDGE, NOT CONTRACT, NECESSARY TO A LIEN. — The Common Pleas Court of New York City holds that where work is done and materials furnished for a building with the knowledge and consent of the owner, a lien may be obtained for same, although the party claiming it made no contract with the owner.

CHANGE OF MATERIAL BY ARCHITECT AND SUBCONTRACTOR. — Where subcontractors use a different material in the erection of a portion of a building from that specified in the contract, by agreement between them and the architect, without the knowledge of the contractors, the latter are not liable for damages because the substituted materials were defective.

PENALTY. LIQUIDATED DAMAGES. — A stipulation in a building contract that the contractor shall pay ten dollars as liquidated damages for each day of delay in the completion of a building should be construed as a penalty, and the owner cannot complain of the action of a court in allowing him part of his claim for delay, on the theory that it was a claim for liquidated damages.

SURVIVING PARTNERS MUST COMPLETE CONTRACTS. — As a general rule, where a partnership has entered into a contract, and one of them dies after it has been partially performed, his death does not absolve either party from performance, in the absence of an express stipulation to that effect; and the existence of the partnership, with its active functions to be exercised by the surviving partner, is continued until the contract has been fully performed.

RIGHT TO LATERAL SUPPORT. — By the law of the land, an owner of real estate has the right to all above and all below it; and, consequently, may do as he pleases with his own. But his right is subject to the qualification that he must not exercise it to the detriment or injury of an adjoining owner's right. An owner has the right to his own soil, but no more than a neighbor has to his soil. Therefore it is that, in using or exercising this property right, no injury must be done to the other's right. This is a maxim of the law. Hence, when an owner commences to dig a cellar or otherwise along the division line between his land and that of a neighbor (which he has a perfect right to do), he must take care to protect the soil of the latter from crumbling or falling, by its own weight, into the cavity. If he make such protection, then the land of the neighbor has received no injury, but if such protection be not afforded, he is answerable for all damage resulting from such neglect; for "among the rights which adjacent proprietors of lands may have to enjoy the benefit of their contiguity is that of having one parcel laterally supported by the other. It is a right incident to the ownership of the respective lands, rather than an easement which one has in the other."

Recent Brick and Terra-Cotta Work in American Cities.

A Department Devoted to the Interests of the Manufacturer.

CHICAGO is still an infant in architecture, even though she has a right to pride herself on the origin of "skeleton construction," which has made possible the erection of twenty-story buildings on soft, sandy clay.

True, this great infant sprawls over ground seven miles wide by twenty-six miles long; but in this area are included many unoccupied gaps, even prairies. The miles upon miles of cheap structures scarcely worthy the name architecture, and the fact that her two or three dozen skyscrapers are all grouped in one spot, in a radius of five or six blocks, and that her important public buildings and fine residences are but a fraction of those in Boston or New York, make Chicago indeed seem but small and but a beginning (let us hope) of what she will be in architecture.

To speak of recent brick and terra-cotta in office buildings would be to mention a long list, for it is scarcely more than a decade since the first one was finished. The names of the "Home Insurance," "The Rookery," the mammoth "Masonic Temple," the "Woman's Temple," and others are familiar to all visitors. Reference will be made here only to some of the most important office buildings finished within a year.

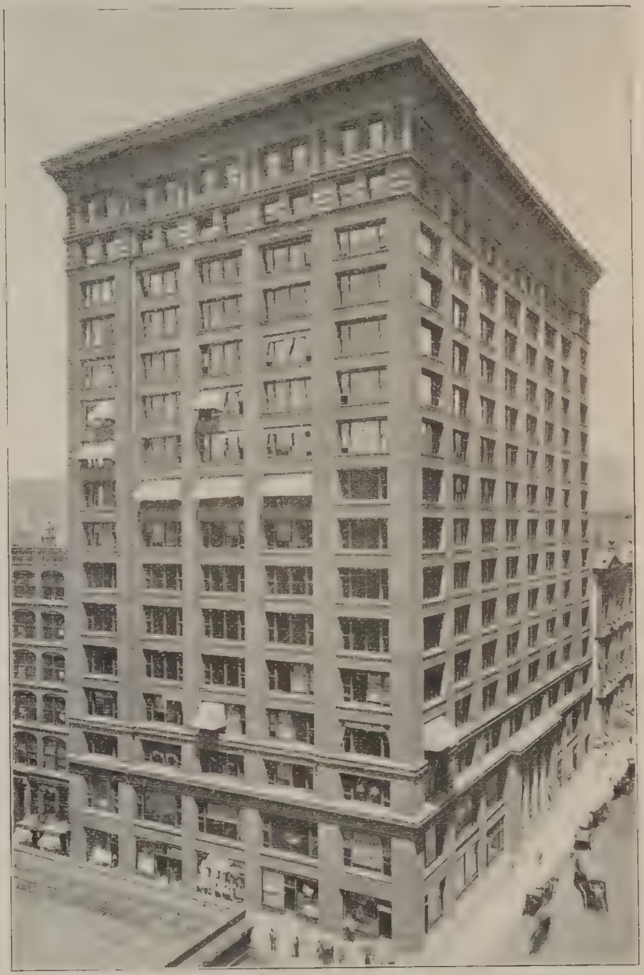
It may be remarked that, aside from the "Auditorium Building," none of the large office buildings have fronts entirely of stone. Several have the first two or three stories of granite or buff Bedford limestone, and the upper part of terra-cotta, or brick with terra-cotta trimmings. The "Columbus Memorial" has the lower stories covered with solid bronze work. The "Reliance" has thin slabs of red granite facing for the first story columns, overlaid with Gothic tracery in bronze. The "Champlain" has cast-iron overlay on brown mottled terra-cotta in first and second stories. The iron is to be painted or gilded.

Some years ago several unhappy attempts were made in designing iron façades. The only recent instance of an iron front is the A. M. Rothschild & Cos'. large department store which (on the wish of the owner, not the architects) has an all cast-iron facing from sidewalk to cornice.

CORNICE OF THE CHICAGO STOCK EXCHANGE.

Perhaps the entirely successful exterior for an office building is yet to be designed. There exist extremes and various gradations which are instructive.

We see above the bronze work of the "Columbus Memorial" Building an over-ornamental facing of terra-cotta, terminating in a confusion of tower, gables, eagles, and torches. On State Street, nearly opposite the "Columbus," stands the "Champlain," a striking contrast. Above the first two (black iron on brown terra-cotta) stories the fronts are a dead white terra-cotta, with such an effect that the first syllable of "Champlain" has been replaced with a word usually represented by a blank. The building is offensively plain to incite such profanity.



MARQUETTE BUILDING.

Holabird & Roche Architects. Face brick furnished by Chicago Hydraulic Co. Enamel brick furnished by Tiffany Pressed Brick Co. Terra-Cotta furnished by Northwestern Terra-Cotta Co. Fire-proofing furnishing by the Pioneer Fire-proofing Co.

Near the "Champlain" stands the "Reliance." The front shows more plate glass than anything else — a point appreciated by scores of owners of old buildings, who are having their fronts torn out and replaced with larger plate-glass areas. And in the light of the fact that dozens of the old buildings are so desperately dirty that they are being painted over — brick and fine cut stone alike — a notable feature of the "Reliance" is the terra-cotta, which is all glazed, and, being cream-white in color, presents the appearance of a porcelain building. A semi-annual water bath will make this building always new. The Northwestern Terra-Cotta Co. are to be congratulated on the uniformity of results obtained in the color and the glaze. The owner of the "Reliance" very kindly showed the writer one of his ideas embodied in suites of doctor's offices having central reception-rooms. Mr. Hale has furnished these suites handsomely throughout, including dental chairs, instrument tables, and cases. A physician can have the use of a handsome suite, including bath, one hour per day for twelve dollars per month. In one of the upper stories is a neat little prescription drug store, making the conveniences quite complete.

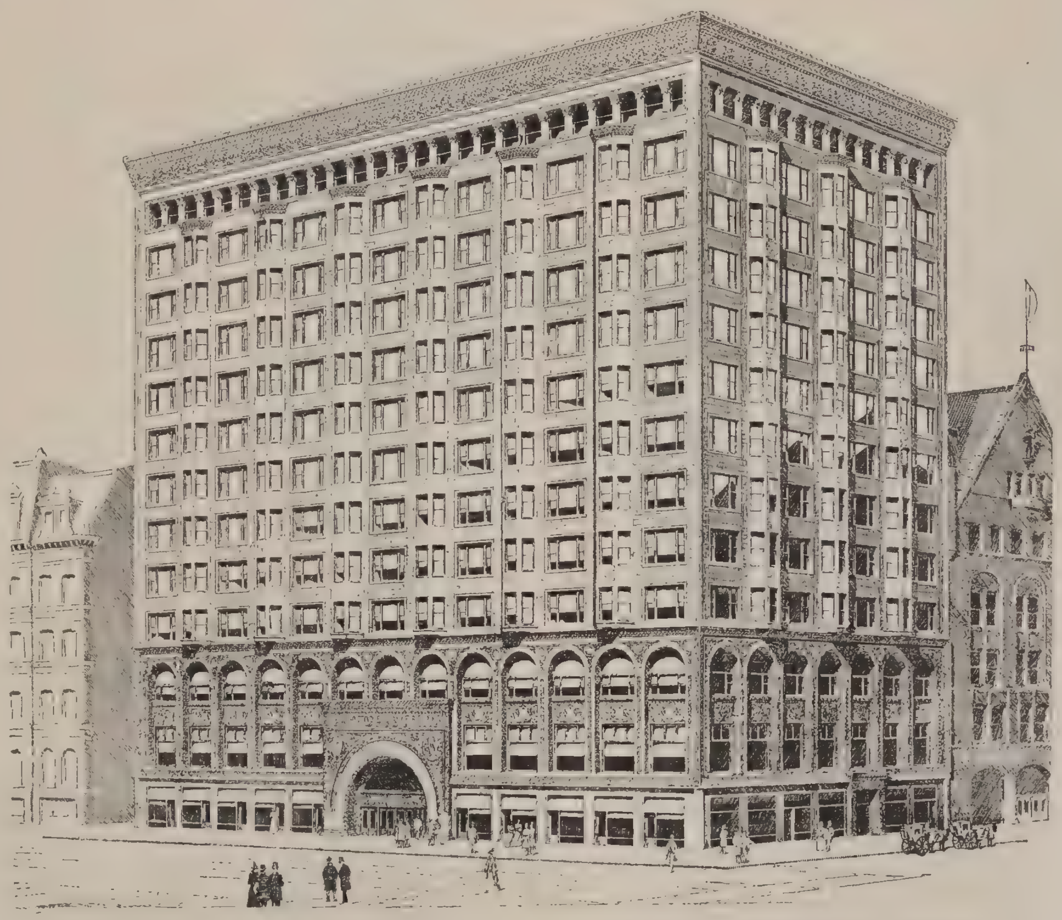
The Fort Dearborn is one of the buildings delayed by the panic nearly a year after the drawings were made, but it came in on the May schedule this year.

Whatever may be said of the exterior design of this building, the color is certainly an unfortunate yellow.

The material is all brick and terra-cotta, except the bases of the first story piers, which are cast iron, and the granite entrance columns.

There is a certain similarity in the plans of office buildings, but the always varying combination of size and shape of ground, location of entrance, elevators, light court, second story bank and proper entrance to same, make an ever varying problem. The Fort Dearborn had several disadvantages to be met in planning. The site is small and there is no alley approach for freight or fuel. But altogether the result is successful; there are no dark rooms and the building is renting well.

The Stock Exchange belongs to the season of '94 (office buildings can be designated like bicycles, since it takes only eight or nine months to build one). Mr. Sullivan's design may be called unarchitectural, and otherwise be criticized, but the fact remains that his work has a most remarkable individuality, and this building commands the admiration of everybody — unless it be jealous cities. The entire front is of terra-cotta in a warm yellow-gray, which is the most popular and certainly the best terra-cotta color in use in Chicago.



By permission of "Ornamental Iron."

CHICAGO STOCK EXCHANGE BUILDING.

Adler & Sullivan, Architects. Terra-Cotta furnished by the Northwestern Terra-Cotta Co.

The "Old Colony" Building is one of the most successful designs yet made as far as the exterior is concerned. The lower stories are stone and the upper ones are Eastern Hydraulic colonial-yellow brick, with nearly white lintels, sills, and mullions. The interior of the entrance is too restricted and gives an instructive lesson in comparison with the New York Life entrance, which is similar in plan. (The New York Life was published a year ago.)

The finest office building in Chicago is the "Marquette." In size it is immense. The color of the exterior is a dark brown and the design in detail and general effect is good. Some of the canons of art are violated, but when the result is so good as this no apology is offered, when constructive reasons in a business building put a column on the axis of the main entrance. The violent entasis of the granite columns is more disagreeable than the lack of a "void on the axis."

The building is handsomely finished in mahogany and Italian marble. The main entrance vestibule gives a curious effect, with its single marble column in the center and beams radiating toward the elevators. It is richly finished in mosaic and white marble. Large balustrade panels at the second floor level are emblematic pictures in mosaic, having a strong green effect. The ceiling panels between white marble stiles are white mosaic with pale pink and greens intermixed in delicate patterns. The exterior panels over the entrance doors are bronze high reliefs representing historical scenes in the life of Marquette.

D. Everett Waid.

COLUMBUS. — Unlike many of her sister cities, Columbus is having a very "slow season" this year. Ours is one of those wealthy, steady-going cities not much affected by hard times, and yet something — or many things — make this year rather an inactive one, so far as building is concerned. A tour of the architects' offices elicits the information below as to work just let or about to be contracted for.

Messrs. C. A. Stribling & Co. have completed drawings for a Protestant hospital. This building is to be four stories high, including a basement, the whole designed on classic lines. The structure will be fireproof and modern in all its appointments; the exterior walls will be of brick and terra-cotta.

Architect Riebel reports drawings completed for a five-story wholesale block, to be 187 by 187 feet. The building will be fire-proof throughout; and the exterior walls, buff-pressed brick with terra-cotta trimmings.

Messrs. Mills & Goddard have designed a large plant for the Rarig Engineering & Equipment Company. The buildings are all fire-proof, the largest one being 638 by 127 feet in size. The walls are of buff brick inside and outside. The same firm have just completed for the Arion Club, — a male chorus of fifty business men, — preliminary designs for an auditorium to seat five thousand people, a full report of which will be sent in a later letter.

Other architects inform us that they will have interesting work to report next month.

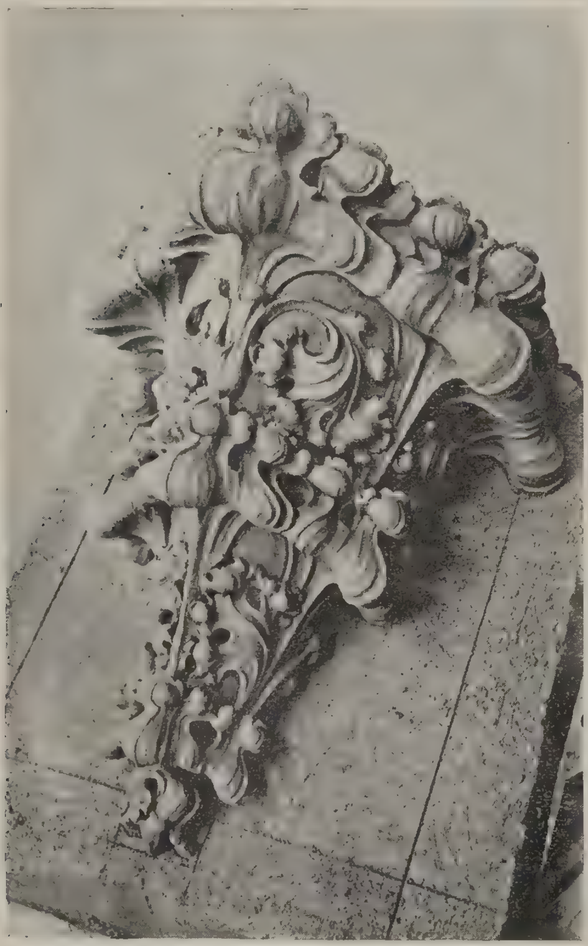
DETROIT. — "The rush is over," is the answer of the architect to the contractors who are persistently inquiring "how is business?" In fact, it is only too true, and, unless some of the proposed buildings materialize, persons having frequent occasions to visit the architects can easily note the increasing amount of signs, "Office moved to residence," which already appear on the office doors of a number of minor architects.

The Detroit Street Railway Co. have purchased a site, and will erect three car barns; buildings to be of brick, each 325 by 80 feet, and from fifty to seventy-five miles of track, for which the city compels them to use brick between, as being the most durable and beautiful material that could be used for that purpose.

Parties are negotiating through a prominent real estate firm for a site on Grand Circus Park on which to erect a handsome office building and concert hall. A deal is now pending, the purchasers having options on several pieces of property, with instructions to buy. No plans have been made as yet, but a building of the above description has been decided on.

ROCHESTER.— Building is expected to boom this year; but it is taking a good while to do so. But the small towns in this vicinity are nearly all having some large buildings erected.

Hamilton, which was burned out a short time ago, is rebuilding, and Mr. O. K. Foote has let contracts for a building which will accommodate nearly the whole town. It is to contain Masonic Hall, banquet and dancing halls, offices, flats, etc., and is three stories, 75 by 200 feet. Mr. Foote has also drawn a bank for same town, which will be erected soon.



EXECUTED BY THE GLENS FALLS TERRA-COTTA CO.

Elmira will build a city hall, and Wolcott, a new union school, and many of Rochester's architects are trying for both.

Messrs. Nolan, Nolan & Stern, one of the best-known firms of architects in the city, have removed from Wilder Building to the new Chamber of Commerce Building (which was designed by them) and are fitting up beautiful offices for their accommodation.

The New York Hydraulic Pressed Brick Company have found that that building is in a good place and more convenient to the architects' offices, and have removed their offices and samples of their stock from 220 Powers Buildings to fourth floor Chamber of Commerce Building.

The corners of St. Paul and Main Streets are becoming a "sort of Architects' Exchange." There are now over half a dozen firms in the two office buildings on these corners, and "still there's more to follow."

It is rather surprising that more office buildings are not being erected. In this class of building there is chance for good investment, as one may see by the way the buildings recently erected were occupied. Much of the office space is spoken for in advance, and most of the other less desirable offices are filled up as soon as ready for tenants.

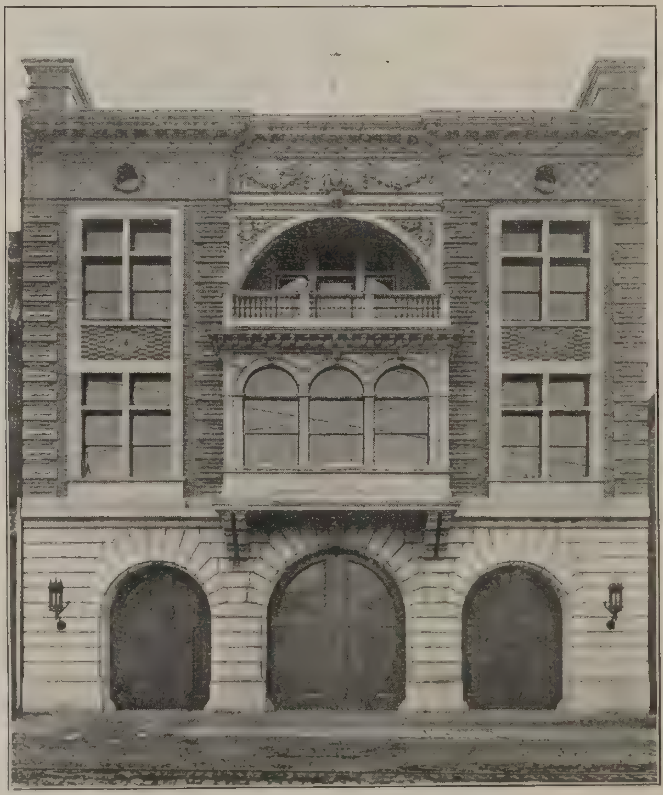
The Rochester Athenæum and Mechanics Institute opens its annual exhibition to-day, and a better display of work by the pupils of the school will be exhibited than has been heretofore. The results of three competitions which are about to be judged will be announced soon, and will be of considerable interest to Rochester draughtsmen, many of whom have entered one or more of them. The subjects are "Pen and Ink Drawing from Photo," "Cover for *The Athenæum*," and a "Wrought Iron Elevator Enclosure."

PHILADELPHIA has, during the year just passed, built several fire and police stations; the one shown in our illustration is situated on Market Street near Twenty-Second, and is probably the most successful of them all.

While they are not "all that could be desired," they are so very far in advance of the usual style and methods of construction, which ruled in preceding years, that they are worthy of notice as probably a turning point toward the better, both in design and general construction; and it would seem that those in command of such affairs are becoming willing to put a reasonable amount of money into a site and building for the purpose required, and not cramp them upon a fourteen-foot lot, as was customary several years ago.

The building shown in the cut is built with a base of Indiana limestone, and two upper stories of buff bricks and gray terra-cotta; the diaper patterns are in one instance of buff and light brown, and in the other buff and white bricks; the projecting bay is of galvanized iron, but the crowning cornice is entirely of terra-cotta.

The interior has been fitted up in the best manner possible with the funds in hand; every convenience available has been adopted.



FIRE STATION, PHILADELPHIA,
John T. Windrim, Architect.

There has been no attempt at fire-proofing; the floors are of the usual joist construction, except the first, where the architect has introduced the Fawcett flooring for the purpose of carrying the weight of the heavy engines, and to furnish a more durable floor for all practical purposes than had heretofore been used.

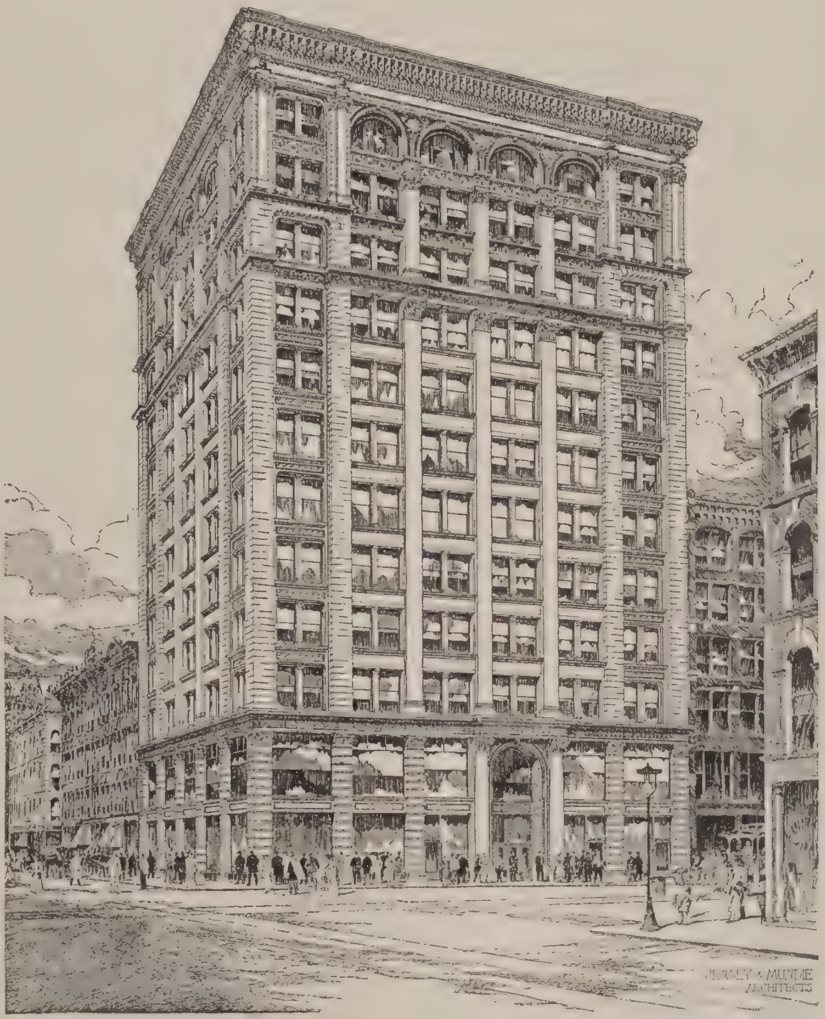
The architect, Mr. John T. Windrim, has taken a step forward in the several buildings entrusted to him, which we hope will prove only a stepping-stone to future undertakings, and which should exert a beneficial influence upon the heads of some of the other city departments.

The new building for the City Trust Company, or, rather, the addition to their present building, will soon be in hand. Architects Wilson Eyre, Jr., and Frank Miles, Day & Bro., associated, have had the work of preparing the drawings under their direction for several months, and they are about completed. The façade of the present building is one of the most beautiful in the city, and one of Mr. Eyre's best and most successful designs (if any one can be said to be better than another), and the addition contemplates the repetition of the present front, with the exception of the first story, which will be altered so as to make a scheme of triple arched openings possible; one of which will be the entrance to the office-rooms in the upper floors, and one the entrance to the banking-room of the company. The top of the building, which at present is a large gable, will also be slightly altered to make the completed building look as one whole.

There is considerable newspaper speculation as to what use the lot on the corner of Walnut and Juniper Streets will be put; as the craze is for high buildings, the reporters have it that a large apartment house will be erected thereon. The architect, Mr. Percy Ash, has, however, been instructed to draw up and he has finished the preliminary drawings and studies for a fine restaurant and café; and the probabilities are that it will be erected shortly. The building will be three stories high, built of brick and stone in the Elizabethan style, and the first floor will have a large ladies' café with glass roof over.

It is to be hoped that this building will soon be a reality, for there seems to be a growing need for just such an one in this locality.

Mr. Ash is the winner of the Traveling Scholarship of the University of Pennsylvania Architectural School, and will finish this work before going abroad to take up his travel and study.



FORT DEARBORN BUILDING, CHICAGO.

Terra-Cotta furnished by the Winkee Terra-Cotta Co. Fire-proofing furnished by the Empire Fire-proofing Co.

GREATER PITTSBURG.— The sound of the saw and the hammer is again heard in all parts of the city and suburbs. Building is more active than since 1893. In anticipation of a good year, much activity is displayed in labor circles connected with the building trades, and while there will probably be some demands for a change in the wage scale, no serious differences are expected. A meeting of Bricklayer's Union No. 2 was held recently, at which it was determined to make an attempt to have the $4.00 per day scale generally adopted.

It is reported that a syndicate will erect a handsome fire-proof hotel, at a cost of about $800,000, on Duquesne Way or at Bellefield, for which Henry Ives Cobb is preparing plans. Longfellow, Alden & Harlow have prepared plans for a hotel building to be erected on Fifth Avenue, at a cost of about $100,000. Geo. B. Post is preparing for D. E. & N. G. Park plans of a fifteen-story office building, 120 by 120 feet, and to cost $700,000, to be erected on the old post-office site. J. S. Stern for D. H. Hostetter, an eight-story brick and stone office-building, cost $500,000, to be at the corner of Grant and Fourth Avenue.

Charles Bickel, for the city of Pittsburg, Department of Public Safety Building, to be eight stories, brick and stone 50 by 150 feet, and to cost $200,000. Architect F. H. DeArment is in consultation with some capitalists concerning a project of immense proportions, in the shape of a free bridge over the Allegheny River, from Fifth Street to Arch; at either ends will be nine-story arcades for business and office purposes. It is contemplated to erect an exchange building; it will cost about $150,000. The North Presbyterian congregation will erect a new church building to cost about $50,000. W. Ross Proctor has prepared plans for a store and office building, to be erected on Center and Highland Avenues, for J. B. Stevenson, to be fire-proof, 50 by 150 feet, four stories, built of pressed brick and to cost $75,000.

A $70,000 building is being arranged for by the Church of the Ascension congregation, on Ellsworth Avenue. The Bank of Pittsburg building, designed by George B. Post, is now under way; the building will cost, complete, $156,000. Thomas Boyd is preparing plans for the Beaver College Building, to be built at Beaver, Pa.; cost, $30,000.

J. L. Beatty has prepared plans for the First U. P. Church, of Wilkinsburg; it will be of brick and cost $30,000. There is talk of a $75,000 business block on Fifth Avenue, McKeesport. Bartberger & East are preparing plans for a five-story factory for R. B. Ward & Co., on Liberty Avenue, of slow-burning construction.

MINNEAPOLIS.— Building matters are very quiet with the architects here, for this season of the year, but, as has been already said, "the Northwest will probably hold off this year to allow other sections to catch up with our improvements."

There is a great deal of work in the sketch stage, which will probably materialize later in the season, and there is good reason to believe that the latter end of the season will find us very active. The majority of the work now being done is small and would not properly come under the head of this article.

Among the more important projects under way and fully decided upon may be mentioned the following: —

Guaranty Savings & Loan Co.; two-story banking building for their exclusive use, 35 by 105 feet in size, in Renaissance style, to be of pressed brick with sandstone trimmings and strictly fire-proof.

Regan Brothers will take estimates within a few weeks for a brick bakery building, 55 by 150 feet; two stories and basement, stores in first story and bakery in second story. Walls to be faced with pressed brick and brownstone trimmings. A feature of the bakery will be the use of white enameled brick for the inside of all walls, also shower baths and private rooms for the bakers, so as to insure the greatest cleanliness throughout. Cost, $10,000. Architect not selected as yet.

"Emerson Court," apartment building for Eric Lund, from plans by H. W. Jones. To be 100 by 165 feet in size, four stories and basement high, of solid brick with red pressed brick facings (Hydraulic Press Brick Co.) and brownstone trimmings. To contain forty-eight flats finished in most complete manner, with steam heat plant, etc. Cost, $125,000.

Congregational Church at Decorah, Ia.; 72 by 80 feet, to seat six hundred. Walls faced with St. Louis granite, pressed brick and stone trimmings. To cost $15,000. Architects, Orff & Joralemon, of Minneapolis.

Same architects have made plans for a Baptist Church at Mason City, Ia., 89 by 84 feet, to seat eight hundred. Walls faced with St. Louis pressed granite brick and stone trimmings; hollow brick lining for walls to be of Pioneer Fire-proof Co.'s make. Cost, $20,000.

We are making great strides, both in our design and construction, and our clients are daily learning the true value of fire-proof construction, especially for office and business buildings.

The masonry on our new court house will soon be complete, and I hope then to give a good description of this immense undertaking in a future letter.

ON Plate 41 and 42 we illustrate the beautiful new Jefferson Hotel, of Richmond, Va. Messrs. Carrère & Hastings, architects.

The exterior is almost entirely of white brick and terra-cotta, furnished by the Powhatan Clay Manufacturing Company. These brick have that uneven surface which is so much desired by architects, and are burned to nearly a flinty hardness, making them almost absolutely impervious to moisture.

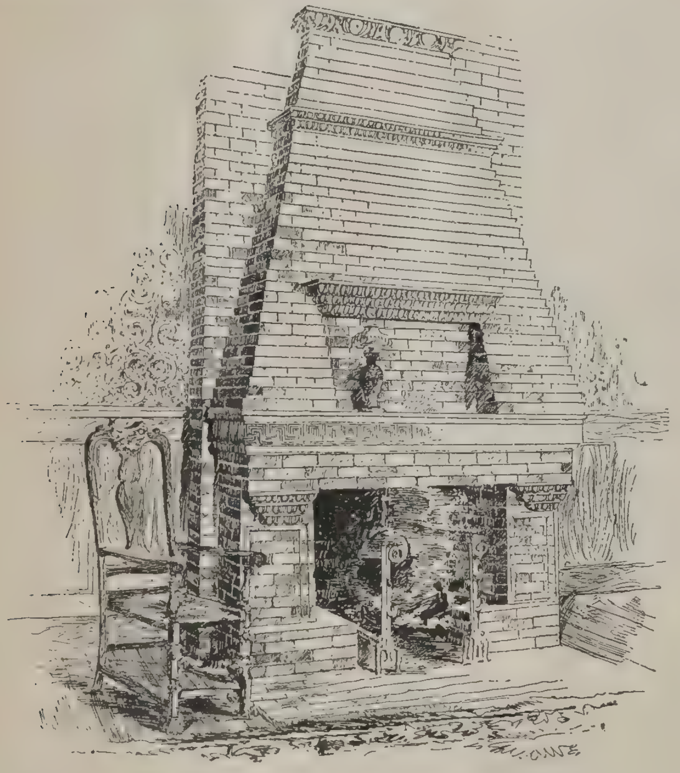
This is, without doubt, one of the handsomest hotels in the country, and its white brick walls add very materially to the general charm of the design.

THE entire plant and property of the Akron Vitrified Pressed Brick Co. has been sold to the Akron Hydraulic Pressed Brick Co., which is one of the plants of the "hydraulic" family.

The beautiful color of the well-known Akron red brick needs no further mention at this time. We understand it is the present company's intention to add a number of new shades to colors now made.

The company has a storage house on the Valley tracks and will carry a stock for quick delivery. They will also handle mortar colors, flue linings, copings, chimney tops, etc.

The Garry Iron & Steel Roofing Co., of Cleveland, has just shipped a large iron building and covering into Texas.



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No. 4 LIBERTY SQUARE, BOSTON, MASS.

VOLVME IIII
JVLY 1895
NO·7

THE BRICKBVILDER

OFFICE 85 WATER STREET BOSTON

THE BRICKBUILDER.

AN ILLUSTRATED MONTHLY DEVOTED TO THE ADVANCEMENT OF ARCHITECTURE IN MATERIALS OF CLAY.

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BELOW we publish the second of the letters which are contributed by the editorial writers for THE BRICKBUILDER, the purpose being, as stated in the June number, to give the ideas of their authors as to the brick now in the market and to indicate the kind of material for which there is an increasing demand.

The writers are architects of the highest professional standing, and these letters should, as they no doubt will, receive the closest attention of the leading manufacturers.

In connection with these letters we should be glad to publish others from the manufacturers, as they unquestionably have their arguments to present to the architect.

COLORED BRICKS.

Some years ago brickwork as a possible substitute for stone in buildings of importance came to the front, and after many years of disrepute brick again came to be considered as a suitable material for the better class of work. Following on this movement came a great increase in the production of bricks of varied color. Hitherto, brick manufacturers, following the demands of the market, had been producing a very accurate and smooth red brick, which, laid up with a fine red joint, was, perhaps, suitable for certain places and certain kinds of work, but was not worthy of the general use to which it was put.

The introduction of the colored brick was a movement of much promise, but color in the hands of the inexperienced is a dangerous thing, and we find now on every hand, side by side with the good work, examples of colors raw, crude, and inharmonious, as far removed from the good examples as the common Romanesque of to-day is from the work of Richardson.

After these two experiments, first in pressed red and then in colored brick, we have noticed a tendency to return more or less to the common red brick as a material at once economical and safe, and, while it can never offer the opportunities which varied colors give, it has, at least, varied shades of color, and that a color which is first rate for exterior work. The history of architecture gives ample authority for the general use of common red brick. Of the various countries which are notable for their architecture, Italy, Holland, and England give us, perhaps, the best precedent for its use. In Italy we have the splendid remains of Roman brickwork and the later brickwork of the Renaissance period. In Holland we find whole cities built of brick, — houses, shops, warehouses, and even public buildings and churches; and in England it would be hard to find any more lovely and typical examples of what is good in architecture than the old red brick houses such as are scattered throughout the land. Now, the brickwork of these countries covers a wide field, and yet it was largely common red brick.

There is, however, one thing about the brick itself which is of vital and prime importance, and which is generally overlooked here. English, Dutch, French, German,— in fact, all brick except ours, — are made of a fixed proportion. The thickness may vary, and we may have four courses to the foot, or seven, or eight, but the length and width are always in strict proportion. Two headers and a joint make one stretcher.

This fixed proportion enables the continental mason to lay up his brick with considerable variety of bond, and yet keep uniformity and have his joints true and plumb; it enables him to make diapers of many designs and keep them regular without ever cutting a brick, and, more than all this, it teaches the mason at the outset how important bond is, and how vital a member of the whole is the individual brick. Once grant that the individual brick is important, and one will not be led into the error of attempting by a fine joint, connecting perfect lines and arrises, to conceal this individuality, and make the whole wall seem like a uniform painted surface.

The common brick is, then, a really important and worthy member of the company of building materials, and we may cite in support of this, from numberless examples, Holland House in London and the Tower of St. Albans, the Waag at Amsterdam and the church at Dordrecht, the church of the Frari in Venice, and Santa Maria's Tower in Rome; and, in our own country, the Virginian Westover, or the church at Alexandria. We are surely in good company when we build of common red brick.

And now as to fancy brick,— pressed red or colored brick. It is true that the better the material the better the result should be, but we think that in architecture, as in all other arts, the workmanship is of far more importance than the material, and better material justifies its existence only when it is the vehicle to show better workmanship. First and foremost, the workmanship ought to be honest and true, and then it may be as finished and as perfect as it can be made. Now, a common brick wall faced with four inches of fancy brick, which are not the same size as the backing, and which, if bonded at all, have merely a blind bond, is not true construction, and no amount of money laid out on the face brick or of skill displayed in the pointing will justify this false construction. But if the more perfect brick are honestly laid, and by their accuracy enable the thorough workman to keep his joints perfectly horizontal, of even widths, and perfectly plumb, then the material justifies itself, and the workman may feel proud of the work of his hands, for, with his fine material, he has accomplished what he could not have done with irregular, common brick.

The same course of reasoning applies to colored brick, though in a somewhat different way; the use of color must be justified by the knowledge and color sense of the designer. If he has not a color sense, and is satisfied merely to specify "yellow" brick, as he might specify "first quality limestone," and never troubles himself to select the yellow which will harmonize with stone or other materials, he proves himself unworthy of his material.

Given perfect brick, of almost any color, thorough workmen, and a skilled designer understanding the material and the use of color, and there would seem to be no material more worthy of honorable use for any kind of building whatever than brick. It is a product of man's hand, and may show the skill of the brickmaker, in making a block perfect in proportion and true in line; the skill of the chemist in combining various clays to produce various colors; the skill of the mason in laying his brick in due order; and, finally, the skill of the architect who, as a true master builder, grasps all the possibilities of the material which he finds at his hand.

R. C. S.

RESULTS OF THE CITY HOUSE COMPETITION.

MESSRS. H. Langford Warren, C. Howard Walker, and C. H. Blackall, who acted as judges in THE BRICKBUILDER Competition for a City House, the front of which was to be of brick and terra-cotta, cost not to exceed $16,000, have made the following awards:

First prize, $60, Edwin R. Clark, Lowell, Mass. Second prize, $40, Edward E. Hendrickson, West Philadelphia, Pa. Third prize, $20, Thomas Wight, Linden, Union County, N. J.

Those receiving special mention are: Will S. Aldrich, Boston, Mass.; Lewis Stewart, Trenton, N. J.; H. G. Fletcher, Boston, Mass.; James Webster, Boston, Mass.

There still remains to be judged the specifications for constructing a similar house so that it will be fire-proof. At the time of going to press we have not received the committees' full report on the competition, and as a consequence we are obliged to postpone the publishing of same until the August number, at which time the successful designs will be published, also.

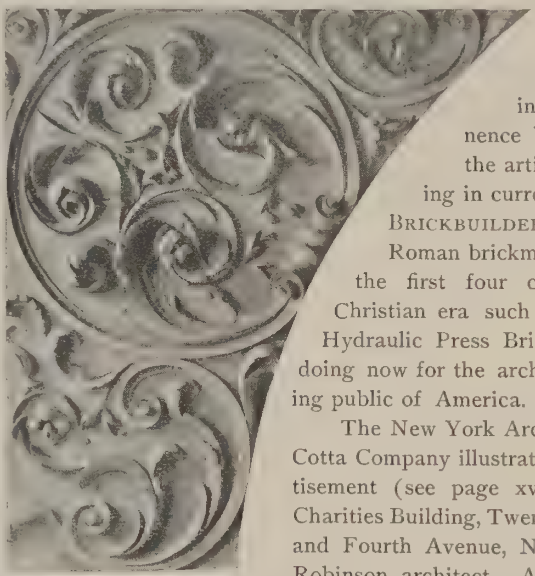
WE request the privilege of keeping the drawings submitted in the Competition until plates shall have been made from them, after which they will be returned to their owners, all charges prepaid.

COMPETITION.

WE are authorized by the New York Architectural Terra-Cotta Company to announce a competition for the best design for a full-page advertisement to be used in THE BRICKBUILDER. The drawings must be made in line with black ink on sheets cut to the uniform size of 14 by 18 inches. For the best designs there is offered a first prize of $50, a second prize of $25, a third prize of $15, and a fourth prize of $10. The prizes will be awarded by a jury of three architects of acknowledged reputation. Each drawing must be marked with a motto or cipher, and a sealed envelope similarly marked containing the full name and address of the designer must accompany the drawing. These envelopes will not be opened until after the award is made. The designs for which prizes are awarded will become the property of the New York Architectural Terra-Cotta Company. THE BRICKBUILDER reserves the right to publish the successful designs. Other drawings, at the conclusion of the competition, will be returned to the competitors. Drawings must be delivered flat, express or postage prepaid, at the office of THE BRICKBUILDER not later than October 1.

OUR ILLUSTRATED ADVERTISEMENTS.

THE subject for this month's illustration in the advertisement of the Hydraulic Press Brick Company (see page xix) is a portion of the Campanile of Chiaravalle.



The important part which brick, as a building material, has played in mediæval architecture has been brought into due prominence by Mr. Cusack in the articles now appearing in current issues of THE BRICKBUILDER. What the Roman brickmakers did during the first four centuries of the Christian era such concerns as the Hydraulic Press Brick Company are doing now for the architects and building public of America.

The New York Architectural Terra-Cotta Company illustrate in their advertisement (see page xviii) the United Charities Building, Twenty-Second Street and Fourth Avenue, New York, R. H. Robinson, architect. As we have not in hand at this time photographs of the details used in this building, we publish instead a panel and capital executed by this company for the new office building on Broadway, New York, for John T. Williams, Esq.

THE ever-welcome *Review of Reviews* comes to our table for July laden, as usual, with the more interesting events gathered from the records of the world's daily doings, and put into such concise form that "he who runs may read."

WITH the August number we shall commence publishing the measured drawings of Italian brickwork, by Mr. C. H. Alden, Jr., as announced in our prospectus for 1895. In all there are twelve of these drawings, which are of a most interesting character,— one of which will be published each month.

HUGH TODD, architect, has entered into partnership with J. F. Walker. Address Todd & Walker, Los Angeles, Cal.

F. A. GUTTERSON, architect, formerly with Ernest Flagg, has formed a co-partnership with F. W. Kinney, and opened offices in Mason City, Iowa. They would be pleased to receive catalogues and samples.

THE AMERICAN TERRA-COTTA AND CERAMIC COMPANY, of Chicago, of which W. D. Gates is president, has removed its offices from Manhattan Building to the new Marquette Building, corner Dearborn and Adams Streets.

PLATE ILLUSTRATIONS.

THE plate illustrations for this month consist entirely of the work of Shepley, Rutan & Coolidge.

Conant Hall, Harvard College, is a four-story dormitory, containing forty-four suites of two rooms each, three single rooms, and a janitor's room, also bathrooms and lavatories on each story.

The exterior of the building is built of hard-burned, rough brick, laid in Flemish bond with dark headers, the cement joints rather a light color. There is a granite plinth next the ground and a projecting base course, in which the cellar windows occur, about 4 ft. high. The top of the base course is molded rough brick.

The first story is brick rusticated work, every sixth course being recessed and composed of dark headers. The arch of the main doorway is constructed in the same manner.

The string-course at the second-story level and the balcony over the front entrance are buff Amherst stone, also the string-course at the height of the fourth story and the tablet with the inscription. The second-story staircase window is a large arch, the voussoirs projecting slightly from the surface of the wall. All the windows have flat arches of brick molded to suit the radius of the arch.

House for Mr. Joseph H. White is built of hard-burned, rough brick, laid in Flemish bond with dark headers, with gray terra-cotta trimmings, the terra-cotta having a surface similar to crandalled stone. All the sills, jambs, and lintels of the windows; copings of gables, walls, and chimneys; the arches and columns of loggia, balustrades, front wall, and gate posts are of gray terra-cotta, furnished by the Perth Amboy Terra-Cotta Co. In the balustrade of the terrace, which is made of brickwork with a terra-cotta capping, glazed, modeled, pottery tiles of a greenish-blue color, which are imported from China, are inserted in the panels.

Bushnell Building, an Office Building in Springfield, Ohio. The first story is of Kibbe stone; the remainder is of Roman brick of a rust color with gray terra-cotta trimmings. The cornice is entirely of terra-cotta. The brick are made by Harbison & Walker of Pittsburgh, and the terra-cotta by the Northwestern Terra-Cotta Co.

House for Wm. Dickenson, Esq., in Chicago, Ill., is built of buff brick with buff terra-cotta trimmings. The cornice and balustrade are of terra-cotta. The basement and the entrance porch are of limestone. The brick are made by the Hydraulic Press Brick Co., and the terra-cotta by the Northwestern Terra-Cotta Co.

The house in Washington is of light-gray brick and all the trimmings are light-gray terra-cotta above the first story. The first story is of gray limestone.

Mr. Wm. Connors, Troy, N. Y., the well-known manufacturer of "American Seal" Mortar, Stains, and Roofing Cement, authorizes us to announce a competition for the best design for an advertisement to be used in The Brickbuilder. The wording which is to be incorporated in the design may be found in Mr. Connor's advertisement for this month on page xxv.

The drawings must be made in line with black ink on sheets cut to the uniform size of 4 by 11 in. Each drawing must be marked with a motto or cipher, and a sealed envelope similarly marked, containing the full name and address of the designer, must accompany the drawings. These envelopes will not be opened until after the award is made. The designs for which prizes are awarded will become the property of Mr. Connors.

For the best design, there is offered a first prize of $25, a second prize of $15, and a third prize of $10.

The prizes will be awarded by a jury of three gentlemen competent to judge of this class of work.

Drawings must be delivered flat, express or postage prepaid, at the office of The Brickbuilder, not later than October 1.

There were fifty-three sets of drawings submitted in the City House Competition, coming from all parts of the United States.

BRICK AND MARBLE IN THE MIDDLE AGES.

G. Edmund Street.

CHAPTER VIII. — *Continued.*

WE cannot do better than take as an example of the finest type of a Byzantine palace the magnificent, though now desolate, decaying, and ruined façade of the Fondaco de' Turchi, once the palace of the Dukes of Ferrara. The whole front of this was originally cased with a thin facing of marble, like the coeval works at St. Mark's,— a kind of decoration which, neglected as this fine relic has been for years, we cannot be surprised to find almost altogether destroyed; small fragments do, however, still here and there remain to tell of the original magnificence of the work. The lower stage of the Fondaco consists of a continuous arcade of ten open arches, with three narrower arches at either end, forming the wings, so to speak; the upper stage has eighteen arches in the center and four in each wing. In the wings the piers supporting the arches are, I think, all molded pilasters; in the center all the arches rest upon columns; and throughout the whole building the arches, which are all semicircular, are considerably stilted. The entire building is constructed in brick, which was originally, as I have before said, covered all over with a thin veneer of marble; in the spandrels of all the arches this is relieved by small circular medallions, delicately carved, and over the upper stage is a string-course, above which there would seem to have been a long series of slightly sunk panels with round-arched heads, filled in with delicately arranged and beautifully sculptured patterns in marble. These panels are immediately below the eaves of the roof. Many of the abaci and string-courses and all the thin pieces of marble which form the soffeits of the arches have their projections finished either with a nail-head or dentil molding, and between the shafts of the upper stage there are traces of balconies.[1]

A very noticeable point in the general effect of the façade of the Fondaco de' Turchi is that, from the peculiar shape and great projection of the capitals of the shafts and the narrow span of the arches, the whole of the arcading has, at a small distance, almost the effect of a series of trefoils, and so seems to pave the way for the continuous traceries of the Ducal Palace and other later buildings.

There is a ruined fragment of a house of the same age as the Fondaco de' Turchi in a canal behind the Foscari Palace. Here the center arch is very wide, has four stilted arches on the sides, the archivolts are all delicately carved, and small sculptured medallions are introduced in the spandrels. Here, I think, the red brick of the walls was always intended to be seen. Of very similar character is a much larger fragment on the right of the Grand Canal after passing under the Rialto. Here there are two stories still remaining. The round-arched doorway has two open and stilted arches on each side, and then a space of blank wall; and the upper stage has a group of seven arches in the center and a single arch at each end over the blank wall below. The labels of these upper arches are turned up at the point into an ogee shape, which, strange as it may seem, must be original, as the detail is early, and they are surmounted by a collection of carved medallions and a carved string-course of early style.[2]

The Ca' Loredan has two stages in height, above which all is modern; but all the Byzantine arrangements of these two stages are perfect. There are five open arches in the center and an arcaded pier on each side; and in the next stage, though the division of center and wings is preserved, the arches are increased in number, and, consequently, the columns of this stage do not come above those of the lower stage. The string-courses are formed with a billet mold; the capitals are some of them genuine Byzantine, and some copies of Corinthian. The wall-faces were all inlaid, but they were in part altered in the fourteenth century, when some coats-of-arms and figures were added. Those at the extreme angles are of David and Goliath, and on each side of the center, sitting figures of Justice and Force.

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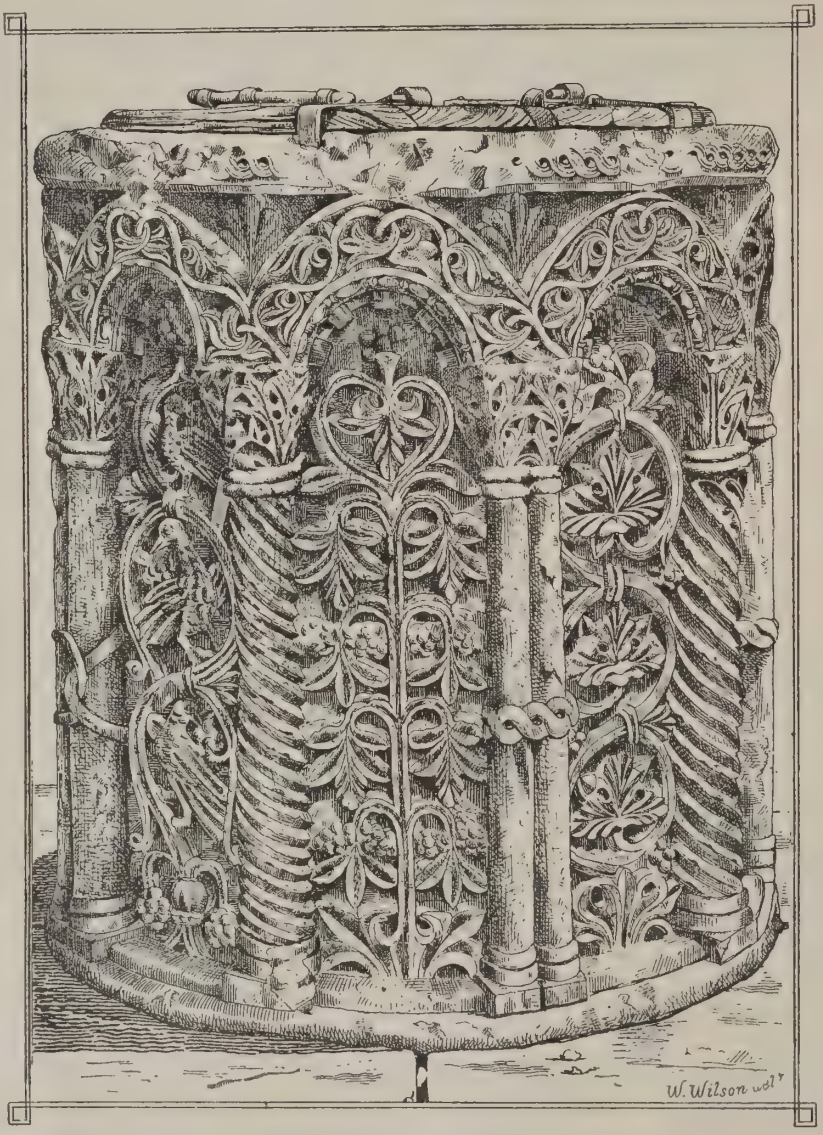
[1] I leave this description as it stood in 1855. Since then the whole of this interesting building has been so elaborately restored that I doubt whether an old stone remains. It has lost all its charm, and this was once intense.

[2] This house is in the Sestiere di Cannaregio, Parrochia San Canciano.

Next to the Ca’ Loredan is the Ca’ Farsetti (now the Municipio), which is, I think, slightly the older building of the two. Here there are three arches resting on shafts in the center, and an equal number resting on piers on each side, and a continuous arcade of fifteen arches on the upper stage resting on coupled shafts.



BYZANTINE WELL, VENICE.

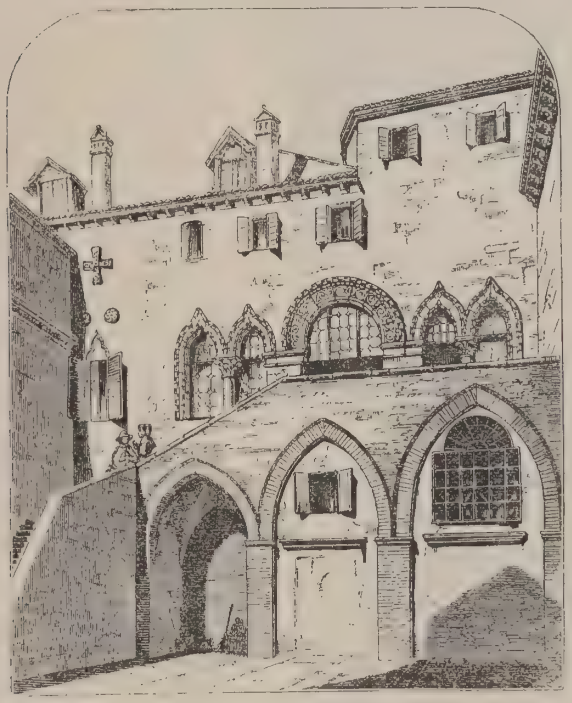
The Palazzo Businetto on the Grand Canal opposite the Ca’ Grimani has remains of Byzantine work in its two lower stages. Here the caps are Byzantine in character, the archivolts flat inlays, with a billet mold on each side, and a carved string-course of running foliage enclosed between two lines of notched or billet mold.

This short notice of some of the more important Romanesque and Byzantine remains enables me to make a few general deductions: (1) These buildings were always of two stages in height. (2) They had the entrance in the center, and had, generally, a distinction between the center and the wings. (3) The capitals were generally Byzantine in character, but often copied from Corinthian. (4) They were of brick, but generally veneered with thin slabs of marble. (5) They were enriched with circular, square, and arched medallions, enclosing carving of foliage and animals, and, frequently, of coupled birds or animals regarding each other, a device always indicative of an early date and an Eastern origin, — and (6) the string-courses were generally carved, either with continuous running foliage or with leaves arranged in threes, the center turning over, the side leaves extended flatwise and upward. This last string-course is exactly copied from Sta. Fosca, Torcello, and is carved all round St. Mark’s inside, whilst the former, though it is Byzantine in origin, is carried round the wall of the Ducal Palace between the southeast angle and the Bridge of Sighs. The illustration of a Byzantine cistern from the center of a courtyard, which I give, is useful as showing very clearly the character of the carved foliage which adorns the string-courses and panels of these Byzantine buildings. This is always effectively carved with deep cuttings which produce bright and sparkling effects of light and shade.

One especial fault of the Venetians seems to have been their proneness to repeat the same architectural idea an infinite number of times; and there is something in this so characteristic of the place and the people that the reason for it is worthy of some consideration. Venice, surrounded by water, and cut off from that kind of emulation which, in other places, always has the effect of producing life and change very rapidly in the phases of art, seems to have contented herself when once she had well done with the conviction that improvement was either impossible or unnecessary; and so, whilst changes were going on in the mainland, to have rested satisfied with a slight alteration only, and that one of detail always, for centuries; and it is thus that I account for the singular sameness which characterized all the efforts of her Gothic artists. The façade of the Ducal Palace is really precisely the same in its idea as that of the Fondaco de’ Turchi or the Ca’ Loredan, altered only in detail, its very beautiful traceries taking the place of but doing the same work as the simple encrusted arcades of its predecessors. And again, in the fronts of other and much smaller palaces, — indeed, in all the fronts of the Gothic period, — it is singular how exactly the same idea in the general arrangement is always preserved. Let me describe an ordinary palace. It is divided into three or four stories in height, the several stages being generally separated by string-courses. The lower story opens, by an arched doorway in the center, to the water, and on either side of this doorway a few small windows serve to light the basement. The second stage has a grand window of some five or six lights, divided by shafts of marble, and rich with tracery in the center, and on either side one or two single lights with tracery corresponding with, and often, as it were, cut out in a slice from the traceries of the central window. The third stage is nearly a reproduction of the second, though sometimes slightly less important; and the upper stage is either again a repetition of the others, or else consists of a few small windows placed over the others, and very unimportant and unpretending. The whole is crowned by a slightly projecting eaves-cornice, generally very meager in its character, and with a line of genuine dog-tooth ornament on its lower edge. Above this, probably, — for only one or two examples remain at all in their original state, — was a parapet like those which still in part remain on the Ca’ d’ Oro, at the back of the Ca’ Foscari, and on the Ducal Palace, light and fantastic to a degree, and almost masking the flat roof behind.

Such, as will be seen by the views with which, I doubt not, almost all my readers must be familiar, is the general idea of the Gothic palaces in Venice, and it admits of very slight modification. Occasionally, as in the Ca’ d’ Oro, the windows are enclosed within a square line of delicate molding, the space within which is encrusted with marble and entirely distinct from the string-courses, so as to give very much the impression of a plain wall veneered here and there with a window; or, again, sometimes the whole central division of the first and second stories is veneered on to a façade in which the other windows are treated constructionally; but in all cases, from first to last (except, as we shall see, in the Ducal Palace, and for this exception there is some explanation in its vast size and other reasons), the distinction between the center and the wings was never lost sight of and never forgotten. This was the great idea of all these buildings, and most perseveringly was it reproduced down to the last, when, gradually losing even the life which beautiful detail had once lent, it sank through successive stages until, at last, easily and well-nigh imperceptibly, it succumbed, without a struggle, to the rise of the Renaissance feeling, giving only in revenge to its successor the curse of an obligation still to go on building to the last, for whatever want or on whatever occasion, with the conviction that a center and two wings must ever be necessary to a grand façade. It so happens that, in addition to the large and purely Byzantine palaces in which this arrangement is preserved,—in a delicate manner, it is true,—there still remains one remarkable example of the period of transition from Byzantine to Gothic, in a house which forms one side of the Corte del Remer (facing the Grand Canal just above the spot where it is spanned by the Rialto), which serves to show clearly the first attempt at translation of this Byzantine idea into Gothic.

In the principal story of this house the central feature is the entrance doorway, whose finely ornamented arch of markedly horseshoe outline is very conspicuous. On either side of this, and connected with it in one group, are two windows divided by shafts and with arches of very singular shape; it is as though a stilted semicircular arch had been suddenly turned up in the center, not with the graceful ogee curve of later days, but with simple, hard, straight lines. Beyond these windows, one of later date, but probably inserted in the place of the original window, completes the similarity which the arrangement of the openings in this house bears to that common in all the later Gothic palaces. The arches which support the staircase in front of this house are entirely executed in brick, and are probably later in date than the house itself, though it is noticeable that they are of a very early and pure type, and that here, as generally throughout the north of Italy, the pointed arch was first used in construction, and then, some time after its first introduction, and very generally in some modified form, for ornamentation, also.



CORTE DEL REMER, VENICE.

And now, having so far cleared the way, let me ask my readers to go with me to the Ducal Palace and there undertake a somewhat careful examination of its very famous design.

I shall not enter into a general description of the entire building, because, as this has undergone prodigious alterations since its first erection, it is unnecessary to do much more than refer to the two fronts which still retain, nearly without alteration, their mediæval design, and to those portions only of the interior and courtyard which have not been altered.

The whole building forms three sides of a hollow square; one side rises out of the deep recesses of the Rio del Palazzo, spanned near its outlet by the famous Bridge of Sighs, and is entirely of Renaissance work; the next side, rising from the Riva dei Schiavoni, faces the Giudecca, and is of the purest Venetian Gothic; and the third, facing the Piazzetta di San Marco—the small square which connects St. Mark's with the water—is also Gothic, and of the same type. The back or north side of the palace abuts upon St. Mark's.

I cannot pretend to decide at all absolutely upon the vexed question of the dates of the mediæval portions, because, as the reader will find in an interesting discussion on the subject in the second volume of Mr. Ruskin's "Stones of Venice," it is a source of hot disputes. But the following appear to me to be the main points.

The Ducal Palace was burnt in 1105, restored in 1116, and rebuilt in 1173–1177. The two columns on the Piazzetta were brought to Venice in 1172, about which time the two Piazze were formed. Between this date and 1301 nothing is recorded to have been done to the palace. But even at this date it was a grand building, and is described in 1275 by Maestro Martino da Canale as "Grande e bellissimo a maraviglia."[1] He was equally enthusiastic about the church of "Monsignore San Marco," and of his campanile, "so great and so high that one cannot find its equal." Sivos, in his chronicle (A. D. 1621), says that the Sala Grande was commenced in 1301 and completed in 1310, at which date the Grand Council consisted of nine hundred members; and one Pietro Baseggio is said to have been the architect between 1309 and 1361; he was succeeded or assisted by Filippo Calandario; and both of them, according to Zanotto, were described as being architects, sculptors, and navigators![2] Calandario had raised himself from the humble post of shipbuilder at Murano to that of Capo Maestro of the Ducal Palace, a man of great weight in the city, but finally finished his career only too much in accordance with custom, being convicted as one of Marino Falieri's fellow-conspirators, and hung from the balcony of the Ducal Palace in A. D. 1355.

On the 28th of December, 1340, a decree was issued ordering the construction of a staircase on the east side of the palace to lead to the new rooms, which seems to establish the fact that at this date a considerable portion, at any rate, of the second stage was built. The plague visited Venice in 1359 and 1361, and stopped all work. In 1362, because the unfinished work was going to ruin, the Council determined to complete the new hall; and in 1365, this being done, Guariento of Padua began to paint it in the time of the Doge Mario Cornaro.[3]

The capital next the southwest angle of the lower stage bears a date which appears to some[4] to be 1344 (as to which I have never been able to satisfy myself), and long afterwards we find the date, 1404, on the large window of the highest story of the sea-front. Finally, in 1419, there was a great fire, which damaged the old portion of the building so much that a decree was passed to rebuild it in conformity with the rest, and this work was completed in 1423, when the council sat in their great Council Chamber for the first time; and in 1439–41 the last Gothic work was added to the palace by the Doge Foscari, viz., the Porta della Carta, built (as appears by their contract) by Giovanni and Bartolomeo Bons, between the years 1438 and 1443, in the small space which intervenes between the northwest angle of the Ducal Palace and the south side of St. Mark's. All these dates are important, and, I believe, undisputed, the only question being as to which parts of the building they refer to.

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[1] Zanotto, *Il Palazzo Ducale di Venezia*, i. 39.

[2] *Ibid.*, i. 52–60.

[3] 1362, *die iv. Dec. Quia est Magnus honor civitatis providere quod sala magna majoris consilii nova non vadat in tantum desolationem in quantam vadit cum notabili damno nostri communis: et sicut clare comprehendi potest, leviter potest compleri, et reduci ad terminum, quod satis bene stabit cum non magna quantitate pecuniæ; vadit parsquod dicta sala nova compleri debeat*, etc., etc. Decree in Zanotto, i. 72.

[4] Mr. Burges, in his account of the capitals, *Annales Archéologiques*, Vol. XVII. pp. 74–88.

And now, before I say more about dates, let me describe these two Gothic fronts,— the sea-front and the Piazzetta-front, — and then we may, perhaps, see our way to some sort of comprehension of the relative ages of the various portions of the fabric.

The whole design is divided into three stages in height, the upper nearly equal to the united height of the two lower stages, and faced entirely with a delicate diaper of marble cut in small oblong pieces, which look, save in their texture and color, only too much like bricks. In this marble-faced wall are pierced a number of windows with pointed arches, the tracery of which has been taken out, and in or near the center of each façade a much larger window and balcony, which look as though they had been subsequently inserted. The lowest stage consists of a long and uniform arcade, of very simple pointed arches resting upon circular columns with elaborately carved caps; these have been shortened by some twenty inches of their old height by the rise of the water, and the consequent elevation of the pavement of the Riva, to the great damage of their effect. The intermediate stage is a magnificent arcade, supporting very vigorous tracery, too well known to everybody to require much description, and divided from the stages above and below it by large and pronounced lines of carved and molded string-courses.

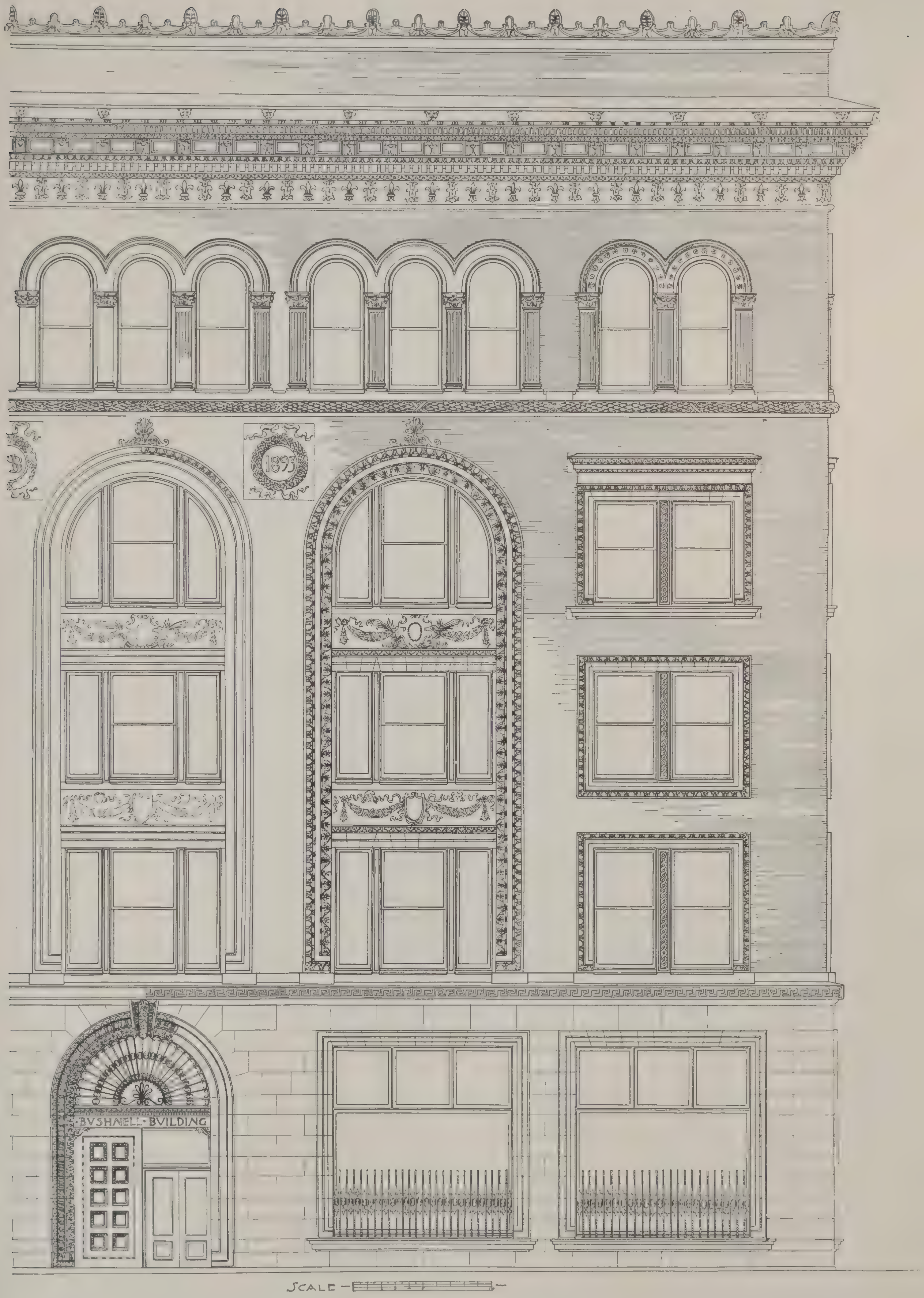
It is important to observe that up to the top of the second string-course the whole of the architecture is of the very best kind of Venetian pointed; the arches of the lowest stage are well proportioned, and, though very simply, still well molded; and the detail of the whole of the second stage is, to say the least, not at all inferior. They form together, without exception, I believe, from all I have either seen myself or heard, the very best and truest specimen of Gothic architecture south of the Alps.

PART OF THE CHURCH OF SANTI GIOVANNI PALO, WITH STATUE OF BARTOLOMEO COLLEONI, VENICE.

Above this noble work the third stage comes, and I confess, to my eye, with patent marks in every stone of which it is composed, that it was designed by some other hand than that which had been so successful below. There is something quite chilling in the great waste of plain, unbroken wall coming above the extreme richness of the arcades which support it; and, moreover, this placing of the richer work below and the plainer above is so contrary not only to all ordinary cañons of architecture, but just as much to the ordinary practise of the Venetians, that I feel sure that the impression which I have had from my first acquaintance with drawings of it is substantially correct, viz., that the line at which alterations and additions have been made is to be looked for rather in a horizontal than in a vertical direction; that in all probability, consequently, the builder of A. D. 1301 commenced with some portion of the sea façade, and gradually carried on the greater part of the building to the height of the two stages as we now see them, leaving his building finished in precisely the same way as the corresponding halls at Padua and Vicenza, two stories in height, with arcades covering the outer walls of the upper as well as of the lower stage; and that when the Council Chamber was found to be too small, and larger rooms were required, another architect suggested the advantage of obtaining them by raising an immense story above the others, and, without destroying much of his predecessor's work, providing rooms on the most magnificent scale for the Doge and his council.

(*To be continued.*)

An architect's tools, to speak in the widest sense, are men. He must be able to inspire confidence, must learn to persuade his fellows, otherwise he cannot have opportunity to express his artistic impulse; but more than this, he must be able to command respect from his helpers, those intelligent tools so necessary to the production of his works. The wider his education on general lines, therefore, the better for him, as for all who find it necessary to deal with men diplomatically.— Henry Rutgers Marshall in *Architectural Record.*



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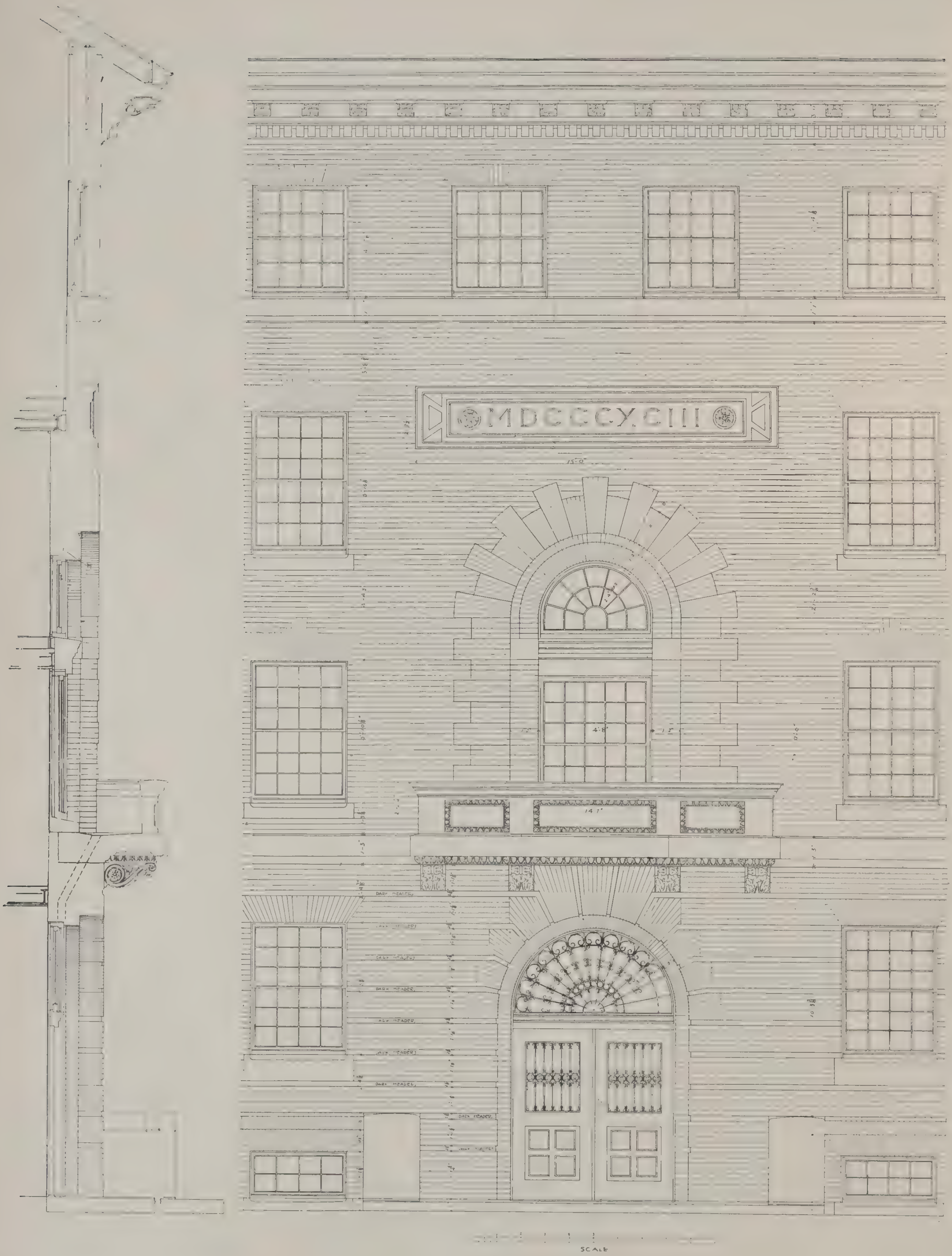

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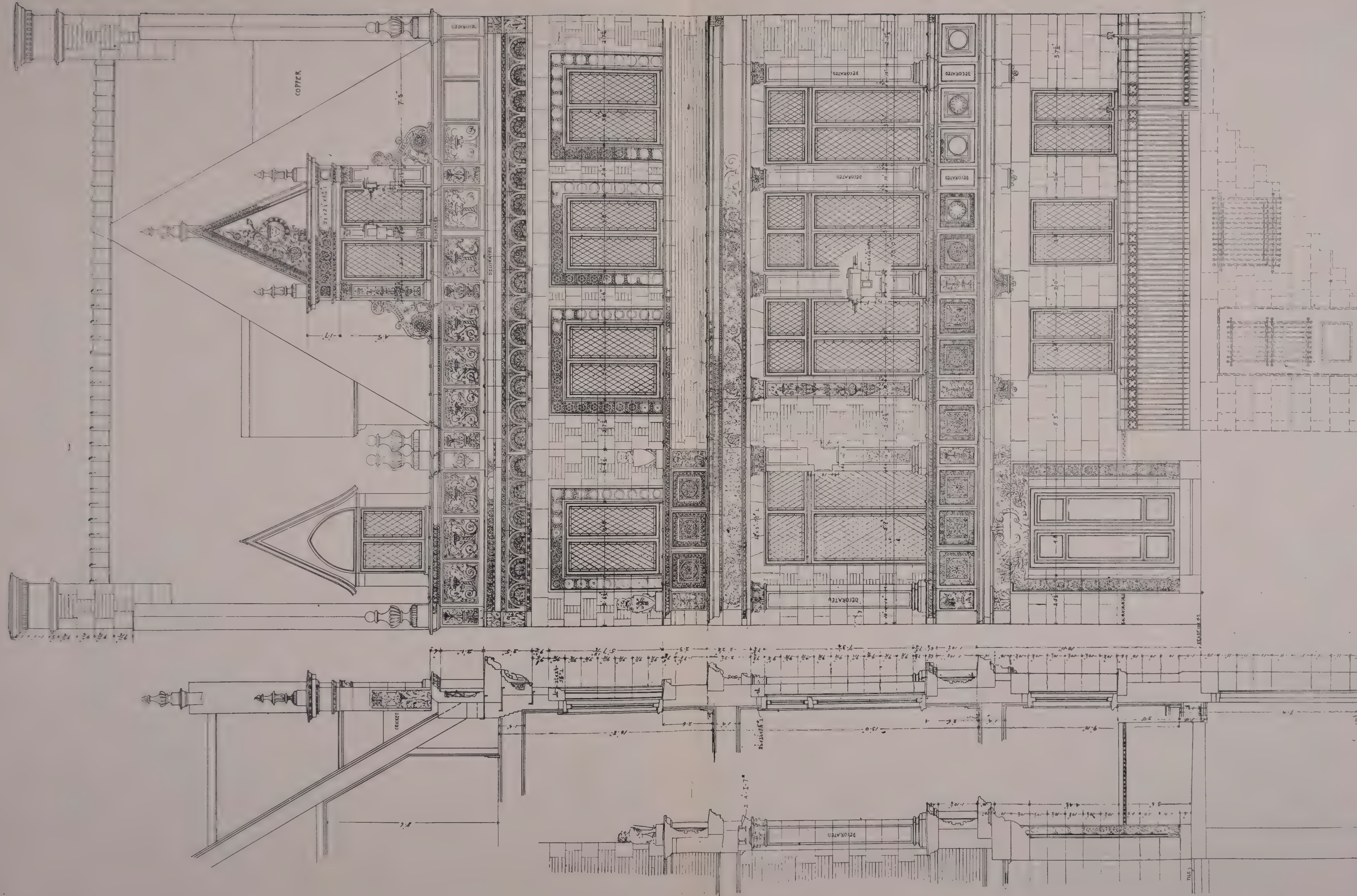
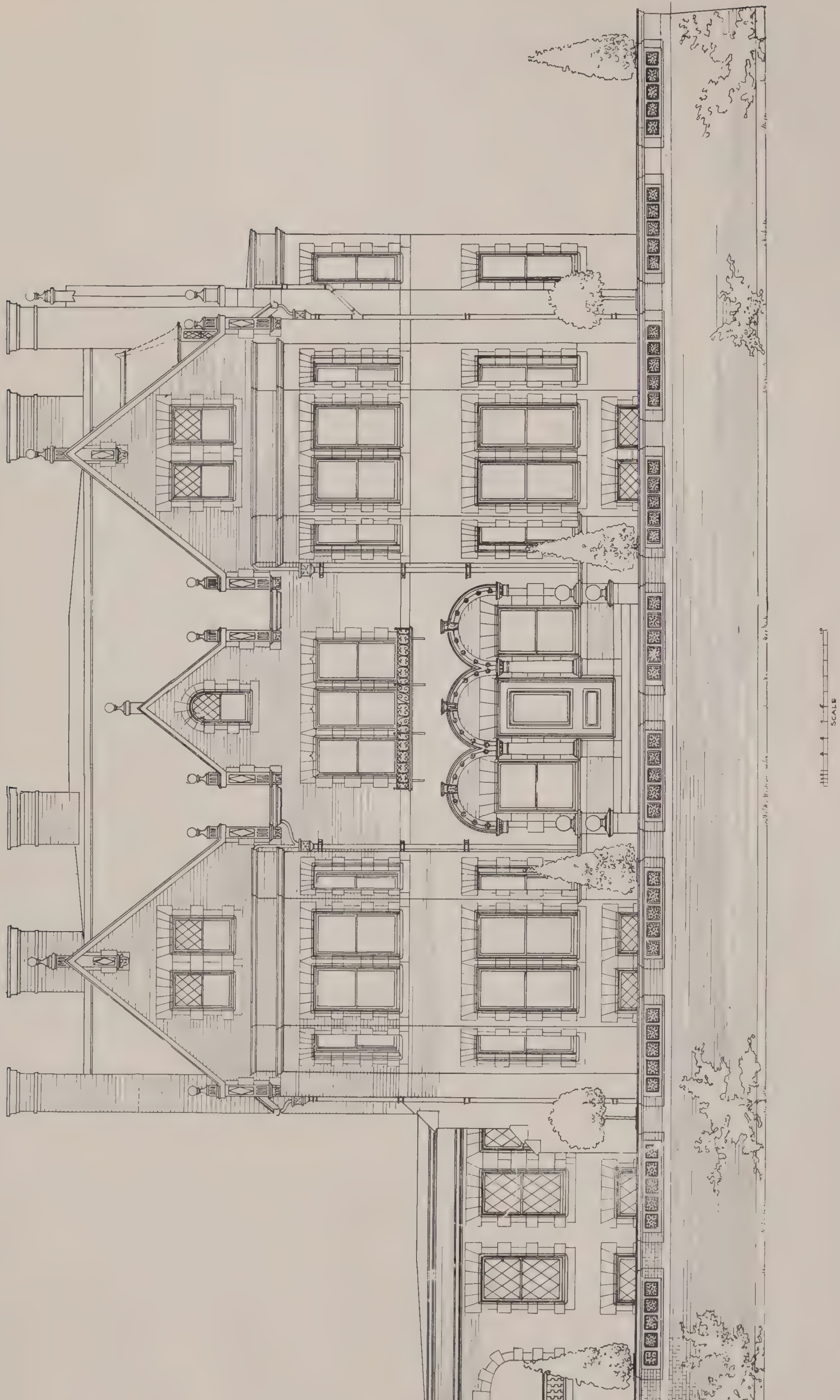


A HOUSE AT WASHINGTON, D. C.

FACADE ALL TERRA COTTA.

SHEPLEY, RUTAN & COOLIDGE, ARCHITECTS.

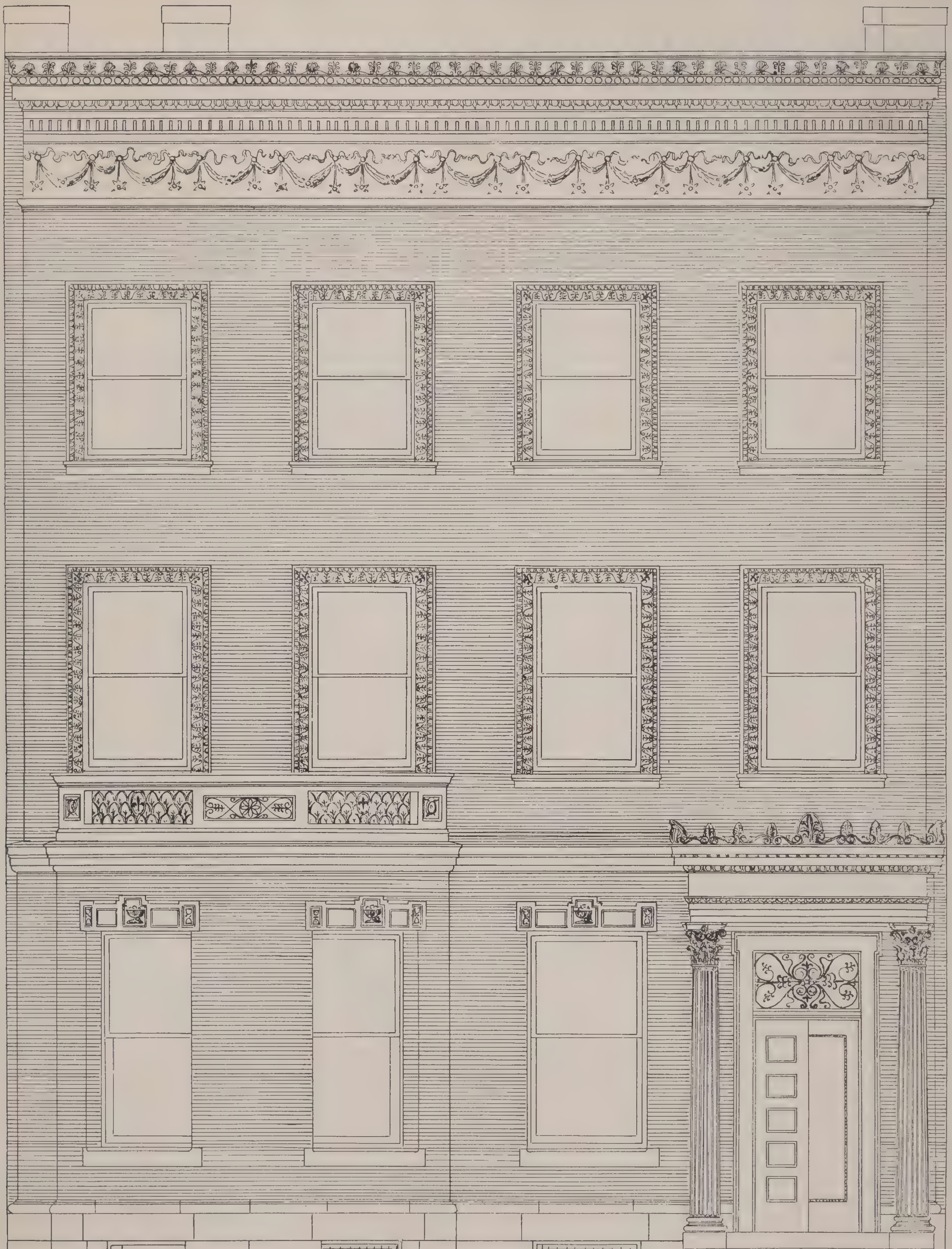
BOSTON. CHICAGO. ST. LOUIS.



HOUSE FOR J. H. WHITE, Esq., Brookline, Mass.

SHEPLEY, RUTAN & COOLIDGE, Architects.

BOSTON. CHICAGO. ST. LOUIS.



RESIDENCE OF WM. DICKINSON, Esq., Chicago.

SHEPLEY, RUTAN & COOLIDGE, Architects.
BOSTON. CHICAGO ST. LOUIS.

THE ART OF BUILDING
AMONG THE ROMANS.

Translated from the French of Auguste Choisy
by Arthur J. Dillon.

PART II.
CUT STONE MASONRY AND ROMAN FRAMING.
FIRST CHAPTER.
GENERAL METHODS OF CUT STONE CONSTRUCTION.

IN studying constructions of concrete the methods used seem to have arisen from one single principle, for the thought of economy dominates them all and gives them a remarkable unity. The study of construction with cut stone will not leave the same simple impression. In buildings of concrete any construction that did not interfere with strength was admissible, for it was to be hidden by the revetment; here, on the contrary, the conventions of decoration were added to the exigencies of the art of building,— a first complication. Then there was the influence of custom, for the Romans had never entirely lost the tradition of the use of colossal stones, which had been handed down to them from the ancient inhabitants of Italy. Yet they used this form of construction with reserve, and their aim was more to make an impression by the grandeur of their conceptions and the wise simplicity of their methods than by showing the difficulties they had overcome. The Greek architects had preceded them in this direction; and so long as it sufficed to follow those masters, the builders of Rome avoided useless and imprudent innovations. Their methods of cutting and using stone were, for the greater part, those of the Greeks; it is therefore necessary, in order to understand them fully, to study them first in the architecture of the Greeks themselves. We will do this by taking up, as an example, the unfinished colonnade of the Temple of Segestum (Plate XXIII.).

One sees, at the first glance given to this ruin, a number of more or less irregular projections on the stones, which are so many indications of the methods followed in preparing and setting the materials of the edifice. These projections are cubes, N, at the angles of the blocks of the stylobate; ridges, such as A and D, along the joints between the stones of the architrave; vertical prisms, B, along the arrises of the abacus, etc.

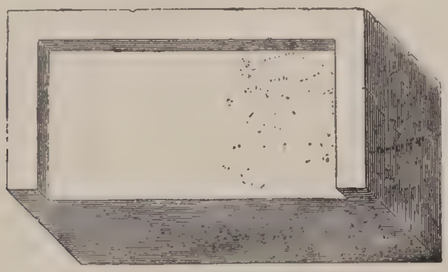


FIG. 59.

What was the object of these projections? Are we to regard them as preliminary to decoration or were they a means of protecting the corners, the angles, or the faces of the stones until they were set? Both of these reasons have a place in a full explanation of the remarkable roughing-out that we are examining; but the second has, I think, the greater importance. The salient cubes, N, left at the angles of the stones of the stylobate, degenerated, during the Roman period, to long prisms, such as those in Fig. 59, which is from the portico of the so-called Agora in Athens. There the projections were evidently not simply decorative; and their role was the same in the monuments of the primitive Grecian art; such as N, (Plate XXIII.), they served to protect the stone, and according as they were damaged or remained intact, they could be removed or converted into ornament when the edifice was completed.

During the first centuries of Grecian art it was not customary to preserve the projections; they were left in cutting the stone only for their usefulness, and when they were no longer needed for protection it was only natural to remove them. Later, when the care given to construction became less, when the protection of the angles became a useless precaution in the view of the incorrections to be found in all parts of the edifices, the Greeks still cut the cubes and prisms in relief on the angles of the stones, but they then did it simply for ornament, and commenced to decorate them with moldings. The Theater of Bacchus affords some examples of this transformation, and I have tried to characterize, by exaggerating, the appearance of some of the stones found in the ruins of this interesting edifice (Fig. 60).

On examining the stones of the architrave of Segestum, we will find that they give rise to the same remarks as the unfinished stones of the stylobate. It is clear that the ridges A and D (Plate XXIII.)[1] were not decorations; they form a border everywhere that the stones come into contact, and this circumstance is indication enough of their origin: they were intended to prevent the two sharp arrises from chipping when the faces of the joints were brought in together.

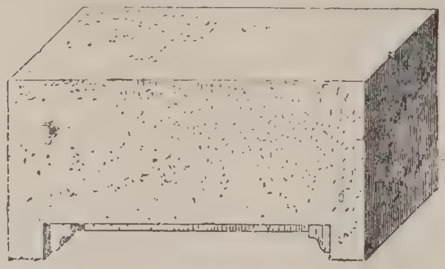


FIG. 60.

Such, also, is the explanation which must be given for the ridges A and D which border the vertical joints of the architrave. These ridges had been already partially removed when the construction was interrupted, and it is shown by this that it was from the exterior face that the workmen first removed the projections. As soon as the stones were in place — in other words, as soon as there was no longer anything to fear from shocks resulting from the meeting of the heavy blocks — they hastened to remove this excess of material which no longer had a reason for existence. Such methods of protecting the joints would have been superfluous if a bed of mortar had been put between the stones, for such a cushion would have diminished the effect of a sudden contact; but with dry joints, the shocks might cause considerable damage to the angles, which the ridges would prevent.

Similarly, the long, nearly rectangular prisms B, on the vertical angles of the abacii at Segestum, were not ornaments which were to remain when the edifice was completed, but were plainly a means of protection for the angles of the capitals, whose great projection exposed them to breakage.

Furthermore, the projections at the centers of the stones of the stylobate served, above all, to protect these faces from damage; afterwards, these, as well as the cubes N at the angles, could be done away with or kept as ornaments, according to circumstances. Projections of the same kind were probably left on all the stones of the pediment, and were cut down at the same time as the ridges A along the joints of the architrave; but on the inner face of the pediment they were left intact, and the stones are to-day to be seen in the same condition as when they were set.

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[1] The prisms, D, were noticed for the first time, I believe, in the unfortunately scarce plates of the magnificent work which M. Hittorff commenced on the ancient monuments of Sicily.

Finally, when it came to the columns, the ancients dressed only the upper and lower beds of the drums in the yards, the vertical faces being left rough; the flutes were only started at the top of the upper drum and at the bottom of the lower, and the final shape was given to the columns when the stones were in place. Such are, in particular, the columns of the unfinished temple, believed to be the ancient Parthenon of Pisistratides, whose debris decorates the southern wall of the Acropolis of Athens; these columns were in the state we have just described when the invasion of the Persians stopped the work.

Later, as we have said, this preparatory work was left visible, and it is to be questioned whether this was from motives of economy or of esthetics. At least, it is certain that the Greeks had no aversion to these so-called temporary forms; they waited before dressing the shafts until all the other parts of the edifice were completed; they commenced the dressing at the upper parts of the building, descending from the cornice to the lower members of the entablature, and then to the capitals; and it was only after these were completed that they carved in the shafts of the columns the traditional flutes. But often, regarding this last refinement as superfluous, they left the columns in their unfinished state; it was thus at the great temple of Eleusis, at the Portico of Thoricus, at one of the temples of Rhamnus, in the ruins of Delos, etc.[1]

If, from the works where art plays a large part, we pass to those of more facile construction, where the absence of curved surfaces would seem to allow more elementary methods, we will find that, while these are simplified, they are still the same.

If it was a question of building a straight wall, the Greeks, in the edifices built with care, did not set the stones entirely dressed; the beds and joints only were finished beforehand, and the faces, if not entirely rough, were at least but very summarily prepared. The whole surface was dressed in a general finishing, and this, the last operation, could be done without risk of mistake and without hesitation, because before setting the stones they took care to cut draught-lines which plainly indicated the planes of the surfaces.

This system is manifest in the unfinished works of the south wing of the Propyleæ of Athens (Fig. 61). The irregularity of the surfaces shows that the present face of the walls was only temporary; the guiding lines frame each stone, or, more correctly, follow the reentrant angles; all the rest was to have been afterwards cut down and reduced to the uniformity of the completed parts of the edifice. In a word, the Greeks proceeded in preparing the face of a wall as in cutting the flutes of a column; grooves previously prepared served in both cases to guide the chisel in the delicate operations of the final dressing of the surfaces.

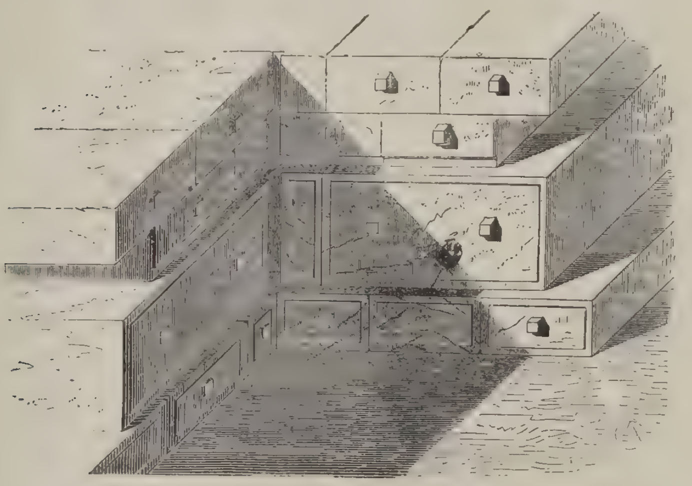

FIG. 61.

If, on the other hand, they wished to avoid the expense and delay of the dressing in place of the preceding operations, not being able to obtain an exact accordance between the different courses, they frankly broke the continuity of the surfaces and laid each course slightly in retreat on the one below it. Thus were executed the undressed walls of the Acropolis of Athens, those of the fortifications of the Pireæ, etc. The last are worthy of special attention, for they show a new manifestation of the tendency to transform into decoration that which originally was only a practical expedient. The sunken frames, which in the Propyleæ (Fig. 61) served only to make the dressing more certain and rapid, have the appearance of panels in the walls, where the stones are still as they were when set. Before, these frames, soberly distributed, bordered the large portions of the walls; here they have multiplied and degenerated into deep grooves along the angles of the stones.

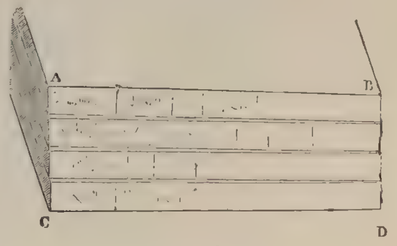

FIG. 62.

The Greeks had a more usual custom of leaving in the center of each stone a projecting tenon, R (Plate XXIII.); these tenons were of assistance in moving the stones or they served to show the amount of stone removed in dressing; they were either for raising the stones[1] or to show the amount due to the workmen for cutting. Even these projections were transformed into ornaments in the hands of the Grecian architects. In the Propyleæ (Fig. 61) they were to have been removed, and also at Segestum (Plate XXIII.) they seemed to have been intended to have only a temporary existence; but in the walls of the Pireæ (Fig. 63) one can see them used as ornament, and it must be acknowledged that their projections, combined with the retreating courses, give to the walls an extreme elegance.

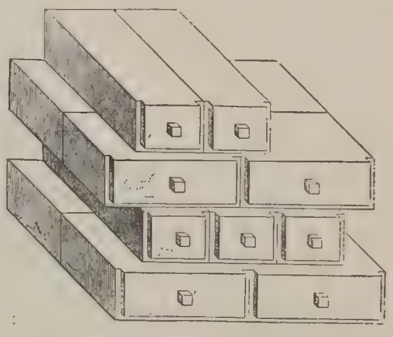

FIG. 63.

(*To be continued.*)

IT seems to me that students should be led to use perspective methods naturally; should be taught to *sketch* out their *projects* in perspective, and then to translate them accurately in terms of such geometrical projections as are needed by the practical workman. This, it will be noted, would be reversing the general method of study. In fact, we should lead the student to think of his building always as it is to be seen, and only secondarily as it is to be made to appear to his mechanical helpers; otherwise we are not teaching architectural design at all, but mere decorative composition upon plane surfaces.

There is this difficulty with the study in perspective, viz.: that we gain but one point of view for each drawing, and the architect will feel himself very unfortunate if the opportunities to view his completed building should be so restricted in fact. We may avoid this difficulty by the making of many perspectives, but more simply and satisfactorily by sketching in the solid, — by making models in clay or wax, or, at times, in paper. — HENRY RUTGERS MARSHALL in *Architectural Record.*

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[1] For these last examples, see Stuart & Revett on the Antiquities of Athens; and for the fragments from the old Parthenon, Penrose's "Investigation of the Principles of Athenian Architecture."

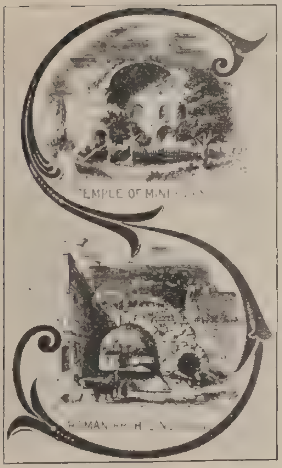
[1] There are cases when there is no doubt that the projecting tenons were for moving the stones, as in the cases of the slabs used to cover the ancient sarcophagi. Each served as a sort of a handle in shifting the stone and, in fact, it was so easy to shift them by this means that the precaution was often taken of removing the tenons, in order to guard against a too facile violation of the tombs. But ordinarily the tenons were only to show the amount of stone cut off, — this was their principal purpose, for they are often to be seen in stones with lewis holes in them.

ARCHITECTURAL TERRA-COTTA.

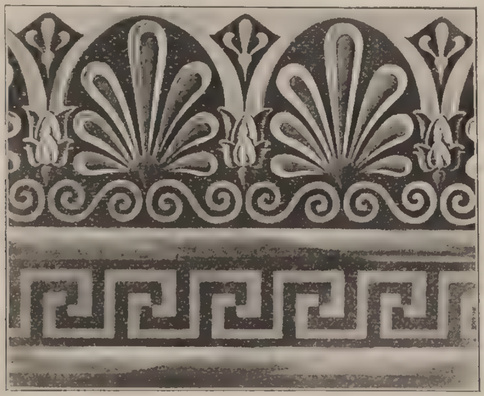
BY THOMAS CUSACK.

(Continued.)

> "Let others better mold the running mass
> Of metals, and inform the breathing brass,
> And soften into flesh a marble face,
> Plead better at the bar; describe the skies
> And when the stars descend and when they rise;
> But Rome! 'tis thine alone with awful sway
> To rule mankind and make the world obey."

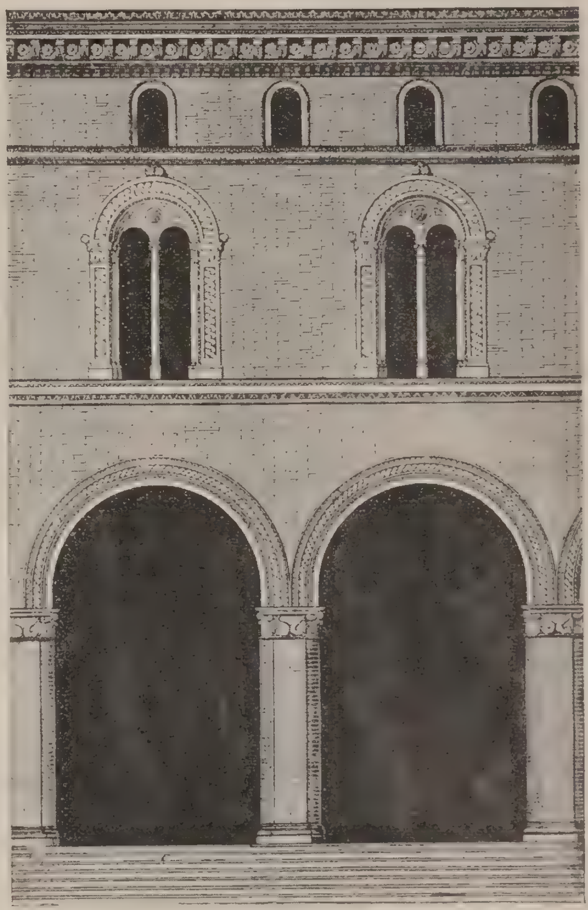


SO wrote Virgil, a great poet, and, for aught we know, "an honorable man," to whom let us hope that Dryden did full justice in this translation. If so, the tuneful Roman of the Augustan Age was lacking in architectural knowledge and appreciation, else he would not have allowed the man-compelling instincts of his countrymen to eclipse their far more meritorious and enduring achievements. His view point may have been too close; hence, the distorted perspective. A vista of two thousand years with the Pantheon in the distance would have enabled him to draw a more satisfactory picture. Rulers of men the Romans undoubtedly were, which to some people would, perhaps, account for their success as brick-makers (after the manner of the Egyptians), if not for their acknowledged excellence in the still more important art of using bricks aright in building. But it is enough for present purposes to know that these industrial arts spread with their conquests, and became known throughout their colonies and dependencies, which at one time extended from the Danube to the land of Cleopatra, and from the Caspian Sea to the Bay of Biscay, thence northward through Gallia, and westward to the white cliffs of Albion. The Roman legions carried war and bloodshed over this vast territory, it is true, but they left behind them other and more beneficent marks of human enterprise. To them, not Italy alone, but all Europe is indebted for examples in road-making, and for whatever there is of a civilizing influence in a good architectural use of bricks and mortar. America is just now discharging its share of this indebtedness by vigorously following their example.



TERRA-COTTA CHENEAU.
Dug up in the Campagna, Rome.

They may have been lacking in the grace and refinement of the Greeks, which had become effete, but for this they made ample recompense, in the utilitarian character of all their projects and the practical way in which these were executed, using for that purpose the material most readily to hand, and evolving a style suitable for its employment. In the solid and scientific use of brick they have never yet been surpassed. Hope in his "Historical Essay on Architecture" claims for them a highly artistic use of this material, and adds: "Far from considering brick as a material fit only for the coarsest and most indispensable groundwork of architecture, they regarded it as equally adapted for all the elegancies of ornamental form, all the details of rich architraves, capitals, friezes, cornices, and other embellishments." The use of brick so inaugurated has never been discountenanced or discarded in Italy, and it is to that country that we still look for inspiration in the architectural employment of clay products. In speaking of the Farnese palace, begun by Bramante and finished by Michael Angelo, the same writer remarks on the excellence of its brickwork: "The plain surfaces are of brick, so fine in its texture and so neat in its joints that by the superficial observer it is generally taken for stone," which recalls a more recent case where history repeated itself in New York City. And in the estimation of so discriminating a critic as Gwilt, we have it on record that "the palaces of Rome are among the finest in Europe, and of those in Rome none equals the Farnese."



PALACE OF FABBIA, BOLOGNA.

Of all the wonderful erections that came into existence from the subjugation of Greece to the coming of Attila, some were demolished by the vandals, and some, it must be confessed, as ruthlessly despoiled by the "pious founders" of Christian basilicas, who, not only availing themselves of temples erected to the gods, did not scruple to carry some away piecemeal as building material. Most of them, however, had been too honestly put together to be easily taken apart, for, though the work of pagans, it could not well have been more thorough if done by Puritans. A goodly portion survived successive wars, mutinies, and invasions, with recurring lapses into barbarism, down through the Dark Ages. And when with the eleventh century came the first dawn of a revival in the Arts, the then existing works of the Cæsars furnished needful lessons in the principles of construction, according to the availability of material, and examples on which were founded mediæval and modern styles of architecture.

In Lombardy, where stone was scarce and clay abundant, brick became well-nigh universal; and by a natural process of evolution blocks of a larger size, and of a constructive, as well as an ornamental character, were molded to required section from a finer grade of the same material, and used very much as stone would have been. Water tables, jambs, and cornice courses soon became available and were set as masonry, along with the red brick of the district, in the Romanesque church of Santa Euphemia at Pavia, erected in the eleventh century. The mediæval brick and terra-cotta thus introduced in the valley of the Po, developed into a some what provincial style, which has been termed Lombardo Byzantine. In this style, some very marvelous feats of construction, as well as of elaborate design, were executed throughout Northern Italy from the twelfth to the sixteenth century. The walling was of brick, and the more important architectural features, as well as the ornamental detail of the interior, were of terra-cotta. To this class belongs the Abbey of Chiaravalle, dating from 1221, with its octagonal campanile starting from a square tower, diminishing in four well-proportioned stages, and pointed with a brick-constructed cone, whose apex rises to a height of 200 ft., and into which the terra-cotta roofing is incorporated. To the same style may be assigned San Gottardo in Milan, with another lofty tower and conical roof. Very little stone was used in this "great country of brick" in any of the ecclesiastical structures of the time, and such as was interspersed, as a means of obtaining contrast and relief from the rich, but perhaps too prevalent red of the neighborhood, has suffered by comparison with the adjoining blocks of hard, close-grained terra-cotta. In some instances, as in San Gottardo, stone was used presumably as a protection to the terra-cotta; but if Majister Franscescuo-de-Pecoraris had lived, say, five hundred years longer, he would have been converted from his skepticism in regard to the time-defying qualities of burned clay. It is the stone, and not the terra-cotta, that has suffered from the prolonged stress of wind and weather. Mr. Ottolini, writing from Milan in 1867, says, "During five centuries this tower has braved the inclemency of the seasons without incurring noticeable traces of decay, although it has not been repaired for so long a time that weeds grow freely upon it."

TERRA–COTTA CHENEAU FROM POMPEII.

FROM POMPEII.

(*To be continued.*)

THE Seventh Annual Competition for the Robert Clark Testimonials, open to architectural draughtsmen under thirty years of age, residents of the United States, not practising architects, will be held under the auspices of the Chicago Architectural Club. Subject, An Art School.

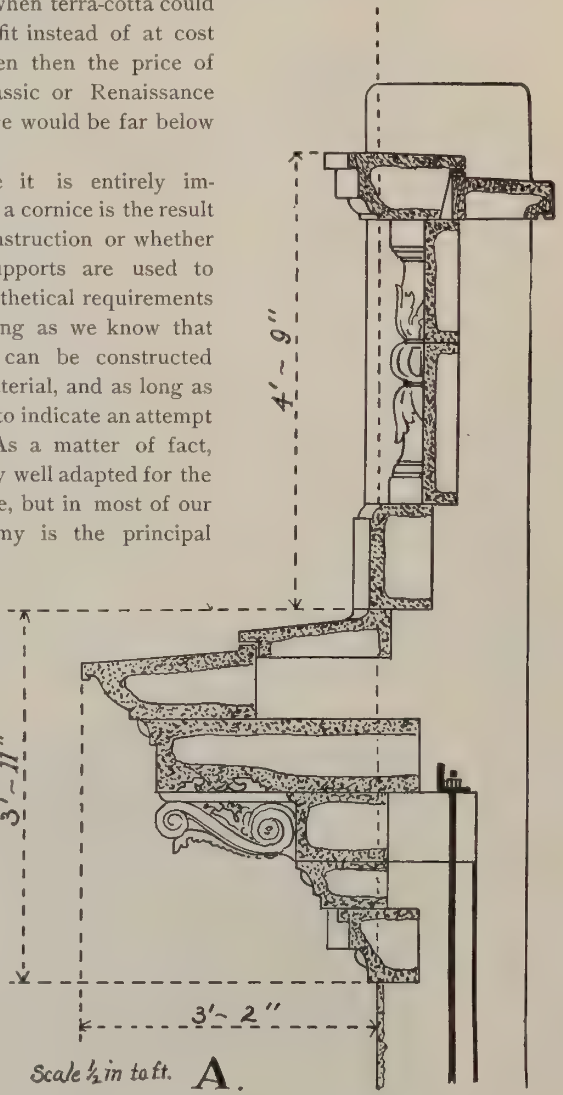
TERRA-COTTA FRAGMENTS.

BY FRITZ WAGNER.

By permission of the Clay-Worker.

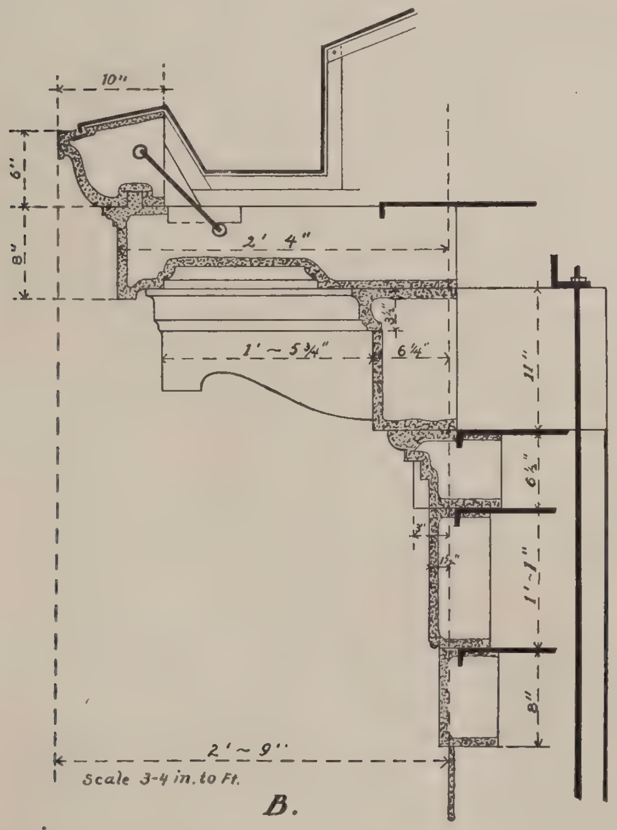
REFERRING to the far-projecting Renaissance cornice, Mr. Twose introduces the question of economy. It is true such cornices cannot be produced economically in terra-cotta, but it is also a fact that even where true construction without the aid of hidden supports be employed a terra-cotta cornice is still a very great deal cheaper than a similar stone cornice. By better kilns, increased experience, and improved methods, and by fierce competition during a period of business depression, the cost of terra-cotta has been reduced nearly 50 per cent. within the last twelve years. There are now to my knowledge nineteen factories in the United States, having an aggregate capacity of approximately 100,000 tons. Their total production in 1894 was about one third of that amount. But even in more prosperous times, when these establishments would be fairly busy, and when terra-cotta could be sold at a profit instead of at cost or at a loss, even then the price of an elaborate classic or Renaissance terra-cotta cornice would be far below that of stone.

In practise it is entirely immaterial whether a cornice is the result of legitimate construction or whether some hidden supports are used to hold it. The æsthetical requirements are fulfilled as long as we know that such a cornice can be constructed from a given material, and as long as there is nothing to indicate an attempt at deception. As a matter of fact, terra-cotta is very well adapted for the modillion cornice, but in most of our buildings economy is the principal factor, and nothing but galvanized iron or copper will go. Our illustration "A" shows a terra-cotta cornice for a building now being erected. It has a projection of 3 ft. 2 ins., and needs no artificial support whatever. The angle iron and vertical anchor rods may be dispensed with; they are inserted for the convenience of the builder. The weight of the parapet wall is fully sufficient to balance the projecting portions by holding down the inner end of the bracket, but even without brackets the soffit piece alone would be sufficient to support the corona and coping. The bracket is about 9 ins. high and 8 ins. wide, by 18 ins. projection. It would require over 2,000 lbs. to break it. The soffit piece is also 9 ins. high, and would break under about 3,000 lbs. per running foot equally distributed. The coping behind the corona is inserted for economical reasons, as the former could easily be made the entire depth. Cornices with 4 or 5 ft. projection could be made of similar construction, but are usually secured to iron framework, not as much for sake of



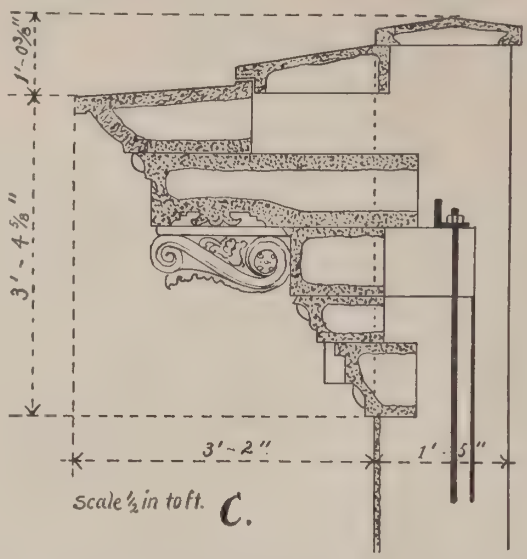
Scale ½ in to ft. A.

economy, but for the reason that our buildings have no walls thick and heavy enough to counterbalance them. Section "B" shows similar construction, but in this case the parapet is replaced by the wall plate and by the weight of the roof resting thereon. This, again, is perfectly legitimate construction. Section "C" is identical with "A," excepting the omission of the parapet. Under these conditions we cannot dispense with the iron anchors, and our construction may be called illegitimate, but we should certainly fare a great deal worse if we had to deal with a similar stone cornice of more than double the weight. In theory this may be sham architecture, but in practise everything goes that looks well. Theoretically, the cornices of nearly all our buildings should not have more than 8 or 12 ins. projection, as the walls are seldom more than 12 ins. thick above the roof; but shall we, just to comply with some imaginary law, dispense with the beautiful effects of the far-projecting eaves? Many art critics smile disdainfully at skeleton construction as an architectural aberration — as something utterly base, and false, and unworthy of serious consideration from an æsthetical point of view. Is it not strange that these gentlemen forget that the most perfect and most beautiful of all art creations, the human body, is nothing more or less than the ideal solution of skeleton construction, the functions of the rigid frame of properly connected bones closely resembling those of the iron columns, beams, and braces, fat and muscles corresponding with brick backing and fire-proofing, while the skin and the terra-cotta facing respectively form the external finish of the structure? There is an almost perfect analogy. While admiring the beauties of man, do you think a great deal of internal arrangements and construction, of blood vessels, and intestines, and the awful skeleton which gives rigidity to the whole? Do you care what that skeleton is made of, or do you think of explaining why the teeth don't drop out and why the knees don't collapse? Now, while the lines of vertical support are clearly shown by the piers, the horizontal floor divisions by the spandrels, and while the bright window-eyes give us a glimpse of interior arrangement of the building, is this not as much as the human body reveals to our eye of its own real construction? Of course, it is essential that a certain amount of flesh and fat be wrapped around the bones of the structure, thus not to become analogous to the living skeleton, for the limit of economy always excludes the beautiful. As long as there is sufficient mass of wall to impress the beholder with an air of stability, our building conforms with the æsthetical requirements; we need not lay it on the dissecting table to find how the muscle is attached to the bone, nor need we stick a bone through the skin to show that there is something inside to hold it up. We don't care. We know it stands now, and feel it must stand; that will do. What should all these anatomical phantasies tend to show? In former papers I tried to prove that terra-cotta may be used constructively very much like stone; by aid of the illustrations published with this number I have clearly demonstrated the fact that it can be used constructively for classic cornices, although it need not necessarily be so used for the purpose. But my principal aim was to show that in skeleton construction the constructive properties of the material may be disregarded altogether, and that a plastic treatment of the entire exterior, where by skilful adjustment of joints and ornaments the former become invisible, and where the same impression is created as though a uniform coat of plastic material enwrapped the entire building, is æsthetically correct — probably more so than the customary surface construction in the mere skin of the wall.



Scale 3-4 in. to Ft.

B.



Scale ½ in to ft.

C.

EGYPTIAN BRICKS.

EGYPTIAN bricks were generally crude,— mixed with straw and dried in the sun; kiln-burnt bricks were occasionally used in foundations, quays, the raised terraces on which the towns were built, or in any situation where they would be exposed to frequent contact with water. The crude bricks were about 15 ins. in length, 7 ins. in breadth, and a little more than 5 ins. in thickness. This simple material was found to be peculiarly suitable to that dry, hot climate, where rain scarcely ever falls, and were further recommended by the ease and rapidity with which they could be made. The brickfields afforded abundant occupation for numerous laborers, and the demand was so great and the trade so profitable that the Egyptian Government took it into their own hands and considerably increased the revenue by this monopoly. In order to prevent unauthorized persons from engaging in this manufacture, a seal containing the name of the king, or some other privileged person, was stamped upon the bricks before they were dried; numerous bricks thus stamped have been found at Thebes and elsewhere. According to Vitruvius, crude bricks should only be manufactured in spring or autumn, in order that they may dry slowly; those which are made in the heat of summer speedily dry outside, while the inside remains moist; the brick thus becomes defective and easily gives way. He further observes that bricks ought to have been dried five years before they can be considered fit for use, and that their having been so should be certified by a magistrate. If these rules originated with the ancient Egyptians, it is probable that the stamp before mentioned may also have been a warrant of the solidity of the bricks.

Fire-proofing Department.

Conducted in the Interest of Building Construction to Prevent Loss by Fire.

FIRE-PROOF FLOOR ARCHES.

(*Continued.*)

BY GEORGE HILL, C. E.

PUBLISHED TESTS. — CONTINUED.

AUSTRIAN SOCIETY TESTS.[1]

INTRODUCTORY: — These were breaking tests, made of such arches as are commonly used in floor constructions and of small spans.

The test arches were erected in a courtyard of the Imperial Military Committee's Building, at Vienna, in the summer months of 1891, 1892, and one at Brün, in 1893.

Of the arches, seven had a span of 4 ft. 5.16 ins., seven of 8 ft. 10.2 ins., both sets having been sprung between iron beams. The remaining three had a span of 13 ft. 3.6 ins., with abutments of heavy masonry.

Four arches were constructed of ordinary bricks, five of flat tiles, three of concrete, three according to the Monier system, two of corrugated iron, and one arch constructed according to the system Melan.

Beside the testing of ordinary brick arches built in the usual two ways,— namely, with straight or diagonal courses,— the investigation of the several patent flat arches now manufactured in Austria seemed desirable, as these arches, giving flat ceilings, are of great value in practical construction.

It was further decided to draw comparisons between concrete and Monier arches on one hand and corrugated iron on the other, as the latter is often used in floors which are apt to be very heavily loaded.

In discussing the manner of building the test arches, and in fixing upon the spacing of the skew-backs, it was maintained that in spacing floor beams the fenestration or spacing of windows of a building was decisive; the distance between window centers reduced to an average was assumed at 8 ft. 10.2 ins.

It was therefore decided to build a series of arches having this span, and a second series having a span equal to one half this window axis spacing, or 4 ft. 5.16 ins.; this second series comprised all flat arches, their span being rarely over 4 ft. 11 ins.

All test-arches comprised in these two series were, for the sake of uniformity, constructed according to the practise usually followed in buildings; that is, they were to have I beams as abutments.

It would evidently have been proper to build the arches in rows, each row to contain at least three arches of one class, testing the middle span. This manner of building would, however, have occasioned too great an expense, even if sufficient space had been available. The same purpose would have been served by building all of the arches closely together; that is, two arches abutting against one I beam. If the work had been carried out in this manner, however, it seems more than probable that a failure or even a decided deflection of an arch would have seriously affected the adjoining spans.

To avoid all these mishaps, each arch was sprung between two I beams of its own, which were prevented from twisting or giving way in any manner whatever by suitable connecting members.

The arches were 6 ft. 6.7 ins. long throughout, the skew-backs being 8 ft. 6.3 ins., and held in place by three round tension bars.

To be able to watch the arches while they were under load, the beam ends were raised three feet above the ground, being placed upon separate piers composed of bricks laid up in Portland cement. Each pier was capped by an iron template and proportioned to the safe carrying capacity of the soil, to prevent all danger of settling.

In selecting the skew-backs and tension rods, an ultimate breaking load of from 819.2 to 1,024 lbs. per square foot was assumed; this load combined with the dead weight of the construction gave a fiber strain for the I beams and tie-rods of from 14,200 to 17,100 lbs. per square inch. Accordingly, for the arches of 4 ft. 5.16 ins. span, I beam, No. 28a and a rod of $\frac{13}{16}$ in. diameter were used; while the arches of 8 ft. 10.2 ins. span received I beam No. 35, and rods of 1⅜ ins. diameter.

The tie-rods had screw ends, nuts, and washers on both sides.

These tie-rods were quite sufficient to keep the skew-backs in place during the building of the arches, but they were evidently incapable of taking any additional strain, such as would result from a loading of the arches. It was, therefore, necessary to tie the ends of the skew-backs together in a manner which would, as nearly as possible, approximate to their being embedded in solid masonry, and reduce all possibility of a change in position on their part to a minimum.

The scheme to be adopted had to be, however, of such a nature as to admit of the watching and recording of any change in form or deflection of the arch which might take place during the test.

For this purpose the connections shown on Fig. 17 were adopted. They were composed of channel bars of sufficient cross-section, which were placed upon the ends of the skew-backs; to each end of a channel bar a pair of angles was connected by means of the plate shown, the angles being placed vertically and in such a manner as to hold the web of the skew-back between their projecting legs. In each leg of these angles two holes were tapped, so that it was possible, by inserting four tap screws or bolts at each connection and setting them up until they gripped the web of the skew-back firmly, to counteract any torsion or buckling of the latter.

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[1] Report of Committee on Arches and Vaults of the Austrian Society of Engineers and Architects. (Translated from No. 20 of the Journal by O. F. Semsch.)

The Austrian Society of Engineers and Architects has always considered it as one of its most important objects to assist in the advancement of engineering and architecture in all of their branches; this endeavor has led it, among other things, to start and carry on exhaustive tests of the different kinds of arch constructions. These tests may be said to have been the result of a motion made in the weekly meeting held on March 23, 1889, by Engineer Victor Brausewetter, who proposed that exhaustive tests be made on the one hand with arches composed of rammed beton, and, on the other, with such built on the system "Monier," to investigate the respective characteristic qualities of the two systems. These tests were to be made under identical conditions for both systems.

The Committee on Cements, to whom this resolution was referred by the Executive Committee, arrived, after mature deliberation, at the conclusion that it would be desirable not to investigate the rammed beton and Monier systems alone, but that the Austrian Society of Engineers and Architects should in this case, as in so many previous ones, take the initiative and institute a series of rationally conducted tests on *all* the customary arch constructions, thus to determine, once for all, the safe carrying capacity of all of these different systems, and, as a secondary consideration, the various qualities, valuable and otherwise, of the materials which enter into their composition.

It was hoped that this would aid in the advancement of the "theory of the arch" in a way which could not be too highly appreciated.

This report of the Commitee on Cements was adopted, and on March 22, 1890, a committee composed of twenty-one members was appointed, in the first place, to arrange an exhaustive program, and then to complete all preliminary work necessary to institute the tests.

Before this committee, known as the "Committee on Arches," went into session, its chairman, Engineer Gaertner, had submitted to its members a paper prepared by himself, in which he had attempted the classification and description of all tests on arches which had been made up to that day; for this purpose, he had investigated the entire technical literature available on that subject. This paper was of great value and assistance in getting up the program for the proposed tests.

Although the active assistance of the commercial concerns interested in the manufacture of arches was surely to be counted upon, it was still evident that the manufacture of the necessary testing appliances and the development of the schemes for loading would necessitate expenditures which would certainly go far beyond the means which the society had at its disposal. Therefore, a request was sent to all government departments, especially the railroad department, also all companies and private concerns,— in fact, all those who are interested in the advancement of science and in the increased prestige of architecture and engineering, — to assist the endeavors of the society by contributing funds, work, or materials.

The extraordinary interest which the proposed tests awakened everywhere, and which found its expression in willing assistance from all sides, made it possible to conduct these tests on a scale never before attempted.

With regard to contributions in money, material, and labor, likewise cost of tests, Section VIII. of this report gives all necessary information; it will only be mentioned here that money was contributed to the sum of about $9,800, while the materials and labor contributed was equivalent to about $10,000. The committee on arches, therefore, considers it its duty to express its obligations for the hearty support with which it has met, and hopes that it has fully accomplished its object, — that of adding to the knowledge of the nature of arches, — by having made or conducted the tests described.

To go completely into the comparison between arches of concrete, those of the Monier system and of brickwork, it seemed also desirable to investigate arches with stationary abutments. These three arches could, moreover, be regarded as a connecting link between the floor arches (having small spans) and those of highway bridge arches. They therefore received a span of 13 ft. 3.6 ins. To prevent any lateral movement of the abutments, these were erected with an inward slope of the joints of 1 to 2.5. They were built of brick, with Portland cement, and their stability increased by placing small piers of medium height on top of them. (See Fig. 18.)

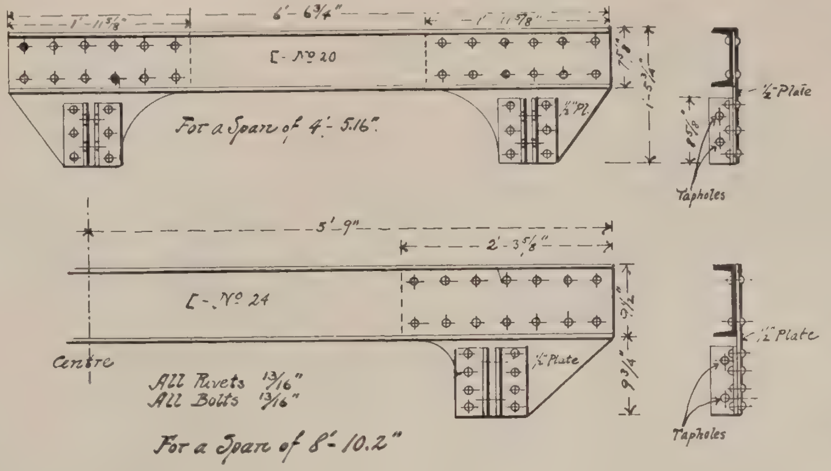


FIG 17-SHOWING MANNER OF CONNECTING ABUTMENT BEAMS

TESTS. For loading purposes iron and steel blooms were available. To get as uniform a load as possible, a layer of cinders, etc., was evenly distributed over the arch to be tested, and a planking composed of floor boards was placed thereon. The testing of an arch took place after it had had at least four months to set.

Short Spans. The arches of 4 ft. 5.16 ins. span could, on account of their small breadth, be loaded over their whole surface only; while the two other classes, those of 8 ft. 10.2 ins. and 13 ft. 3.6 ins. span,— the former sprung between I beams, the latter between masonry abutments,— could be loaded eccentrically.

It should be noted that all arches, though varying in thickness, were constructed for a safe carrying capacity of 123 lbs. per square foot, and, as has been stated above, were expected to fail under a load of from 819.24 lbs. to 1,024.0 lbs. per square foot, this corresponding to a factor of safety of about eight, which conforms very well with good practise.

But in the case of the arch loaded over its entire surface, — that having a span of 4 ft. 5.16 ins.— a load of 1,024 lbs. per square foot not only failed to cause a breaking down of the arch, but even left it intact, so far as dangerous cracks or fissures were concerned, so that the imposed load had to be increased.

The increasing height of the pile of iron blooms made it necessary, however, to take measures to protect the workingmen from injury, in case the arch suddenly failed.

For this purpose two pairs of strong uprights were placed on each side of the arch. These were braced laterally. Into the space between them long horizontal beams were placed, corresponding in height with that of the pile of blooms, which could thus fall against the screen so formed, in the event of the arch failing.

In the case of the first two classes of test arches, brick arches with headers or stretchers (Fig. 19), the loading was interrupted after 1,433.60 lbs. per square foot had been applied, because the arches had as yet undergone no dangerous deflection, and an increase of the load would undoubtedly have led, in the first place, to a deformation of the skewbacks and tie-beams.

In the case of all other arches of this span the load was increased to about 1,638.4 lbs. per square foot, which load actually caused two flat arches (systems Glückselig, Fig. 23, and Schneider, Fig. 22,) to fail entirely, while the two other types of flat arches, including the concrete arch, were still able to carry it with sufficient safety.

The amounts of deflection measured at the crown after each successive load had been applied, as well as all other observations, are given in Table A, the numbers in brackets giving the deflections after the loads had been removed.

To measure the deflection, iron rods of ⅜ in. thickness were

TABLE A. ARCHES OF 4 FT., 5.16 INS. SPAN.

Number of Load.	Load in pounds per square foot uniformly distributed.	Deflection of crown in inches.							REMARKS.						
		Flat arch, system;				Brick arches, with		65	Flat arches, system;				Brick arches, laid		Concrete arch.
		59 Schober, Fig. 20.	60 Hönel, Fig. 21.	61 Schneider, Fig. 22.	62 Glückselig, Fig. 23.	63 Headers.	64 Stretchers.	Concrete arch.	Schober, see Fig. 20.	Hönel, see Fig. 21.	Schneider, see Fig. 22.	Glückselig, see Fig. 23.	Headers.	Stretchers.	
1	102.40	.0197	.0079	0158	.0236	.0236	.0394	.0118	Thickness at crown $3\frac{15}{16}$ ins., rise $1\frac{9}{16}$ ins., weight 130.5 lbs. per square foot. Re 6) joints opened at crown; after load had been removed arch was still intact; no cracks in voussoirs apparent.	Thickness at crown $3\frac{15}{16}$ ins., rise $1\frac{15}{16}$ ins., weight 71.8 lbs. per square foot. Re 4) joint at crown opened, re 5) horizontal opening entire length of arch; after removal of load arch was still intact; no cracks visible on surface.	Thickness at crown $3\frac{15}{16}$ ins., rise $1\frac{9}{16}$ ins., weight 128 lbs. per square foot. Re 4) opening of joint near crown, re 8) horizontal crack in one voussoir, re 19) complete failure.	Thickness at crown $3\frac{15}{16}$ ins., rise $1\frac{9}{16}$ ins., weight 125 lbs. per square foot. Re 3) joint opened at crown, several voussoirs failed; re 5) fragment detached from crown; re 11) one skew-block failed, re 17) complete failure, after all crown voussoirs and skews had been crushed.	Thickness at crown $5\frac{11}{16}$ ins., rise $5\frac{11}{16}$ ins., weight 70.9 lbs. per square foot. Re 7) one voussoir crushed, re 11) opening of joint visible, re 13) a second voussoir crushed; after load was removed the arch still seemed intact.	Thickness at crown $5\frac{15}{16}$ ins., rise $4\frac{7}{8}$ ins., weight 77.1 lbs. per square foot. Re 4) middle joints opened, re 12) cracks visible on several voussoirs; after load was removed the arch seemed still intact.	Thickness at crown and skews $2\frac{15}{16}$ ins., rise $4\frac{1}{2}$ ins., weight 93 lbs. per square foot. Re 3) crack at crown, re 7) second crack all over arch; after load was removed arch seemed still intact, in spite of the great permanent deflection.
2	204.80	.0354	.0197	.0276	.0667	.0315	.0787	.0945							
3	307.20	.0552	.0708	.0591	.1340	.6300	.1379	.1498							
4	409.60	.0748	.0984	.0945	.1852	.0945	.2048	.2480							
5	512.00	.1024	.1419	.1379	.2520	.1340	.2678	.2810							
6	614.40	.1300	.1890	.1772	.3150	.1693	.3463	.2995							
7	716.80	.1576	.2322	.2242	.4095	.2168	.3940	.3543							
8	819.20	.1852	.2719	.2758	.4725	.2600	.4525	.4020							
9	921.60	.2163	.3112	.3270	.5590	.3072	.5195	.4490							
10	1,024.00	.2480	.3463	.3741	.6572	.3662	.5745	.4920							
11	1,126.40	.2758	.3820	.4490	.7640	.4140	.6300	.5350							
12	1,228.80	.3072	.4330	.5240	.9290	.4570	.7160	.5904							
13	1,331.20	.3423	4725	.6140	1.0510	.4960	.8342	.6375							
14	1,433.60	.3820	.5200	.7080	1.1930	.5475	.9522	.6772							
15	1,436.67	.3900	.5390	.7165	1.2020	.5515 [.2205]	.9560 [.6492]	.6810							
16	1,536.00	.4175	.5749	.8320	1.4380			.7160							
17	1,638.40	.4570	.6140	.9480	1.6490 Failed.			.7720 [.7600]							
18	1,646.18	.4650 [.1419]													
19	1,651.30			.9680 Failed.											
20	1,715.81		.6572 [.2758]												

attached to each arch at the crown. Stakes were driven into the ground and cast-iron triangles fastened to them in such a way as to have their two legs absolutely horizontal and vertical respectively; by means of suitable scales, the movements of the iron rod, with regard to the triangle, could thus be measured readily.

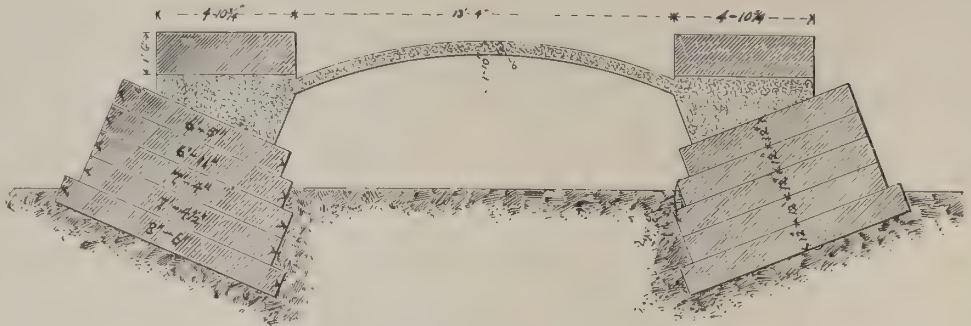


FIG. 18—CONCRETE ARCH WITH MASONRY ABUTMENT.

The movement of the crown in a horizontal sense, while the arch was fully loaded, could only have been incidental; as a matter of fact, these deflections varied constantly and were omitted entirely from the tables.

From a comparison of these seven arches with each other, all having a span of 4 ft. 5.16 ins., the following conclusions may be drawn:—

(*a*) The two brick arches laid up in white lime mortar, with a rise equal to $\frac{1}{10}$ of the span, have, under a load of 1,433.6 lbs. per square foot, shown so little change that the ultimate load can safely be assumed to be very much higher. It may, therefore, be said that such arches — good workmanship and material being guaranteed — will be sufficiently safe for all practical purposes, even with an increased span. But this is only true for a uniformly distributed load.

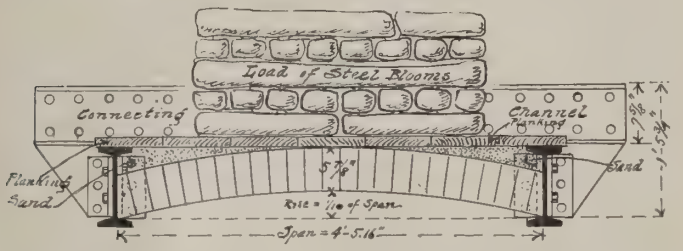


FIG. 19—SECTION OF BRICK ARCH.

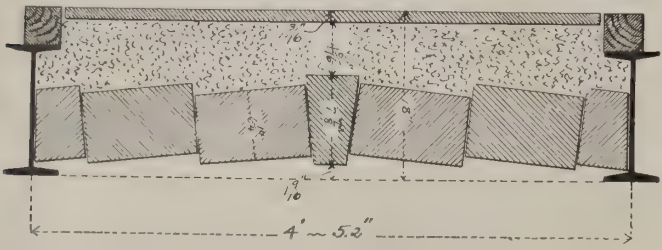


FIG. 20.

Of the two ways of laying this arch,— headers or stretchers,— the latter has in every case shown a superiority, inasmuch as arches laid up in this way deflected less; which may be accounted for by the fact that there are a smaller number of joints, in a section normal to the skew-backs, in an arch of this kind.

(*b*) The deflection of the concrete arch $2\frac{15}{16}$ ins. thick, laid up of one part Kirchdorfer Portland cement and five parts sand, was about equal to the average of the deflections of the two brick arches just mentioned. This arch is, therefore, very well suited to replace a brick arch of a thickness of 5⅞ ins.

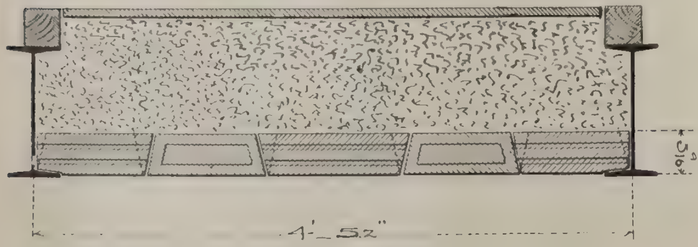


FIG. 21.

Besides the decrease of $2\frac{15}{16}$ ins. in thickness, these concrete arches have an advantage over the brick arches in their lesser weight; hence it is advisable to use this arch wherever good, cheap bricks are not available.

(*c*) The four flat arches have shown an unexpectedly high carrying capacity, and, therefore, afford — provided the skew-back beams are not placed too far apart, and the workmanship is first class, — complete safety for all practical building purposes. *But one must not be too economical in the use of tie-rods*, when adopting any of these systems, to prevent any lateral deflection of the floor beams.

These systems of floor arches show appreciable differences among themselves; two, for instance (systems Schober, Fig. 20, and Hönel, Fig. 21,), gave evidence of a very small deflection, even less than that of the brick arches; and a load of 1,638 lbs. per square foot caused them to undergo very little change, while the two other systems, Glückselig (Fig. 22) and Schneider (Fig. 23) failed under this load, after having shown considerable deflection beforehand.

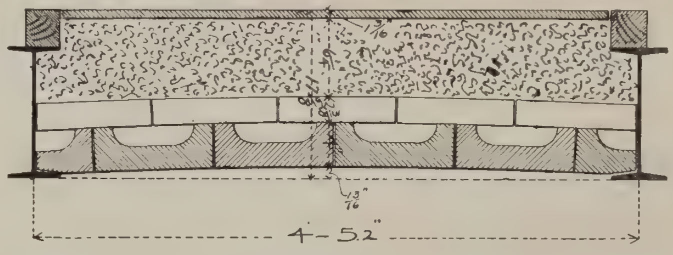


FIG. 22

This may be explained by the fact that the voussoirs used in the two latter systems are of a very complicated form; they cannot, therefore, be made by hand, but dies must be used in their manufacture. This does not permit of the extensive use of sand; the voussoirs, as a consequence, are very brittle, so that they begin to show signs of breaking under a relatively small load (614.4 lbs. per square foot).

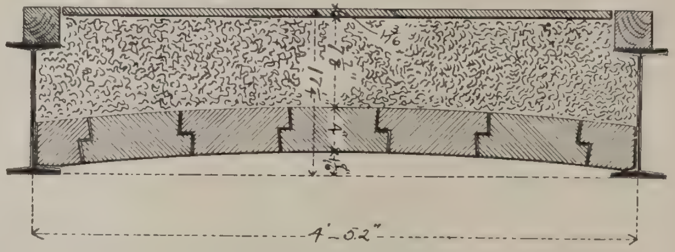


FIG. 23

The peculiar form of the key of these systems further results in an uneven distribution of the load, the stresses being unduly great in some places and very small in others. The concerns manufacturing such systems often maintain that these complicated voussoirs are a very good feature, their shape making it possible to lay the arch up dry; this, however, ought to be regarded as undesirable, for it might encourage careless workmanship.

(*To be continued.*)

Mortars and Concrete Department.

Devoted to Advanced Methods of using Cements and Limes in Building Construction.

AMERICAN CEMENT.

BY URIAH CUMMINGS.

CHAPTER V. — *Continued.*

PROF. E. T. COX, in his report of the geological survey of Indiana, renders an interesting, and, in view of the question of antiquity, a valuable acquisition to our knowledge of ancient mortars and concretes; and the question arises, was the old or the new world the first to produce from materials which to-day would be considered as useless for such a purpose a mortar or concrete, which, being placed below ground, would become hard and stone-like in character and remain so throughout all the centuries that have elapsed since their first fabrication.

Prof. Cox says, "It is not alone in Europe that we find a well-founded claim of high antiquity for the art of making hard and durable stone by a mixture of clay, lime, sand, and fragments of stone; for I am satisfied that this art was possessed by a race of people who inhabited this continent at a period so remote that neither tradition nor history can furnish any account of them.

"They belonged to the Neolithic or polished stone age. They lived in towns and built mounds for sepulture and worship, and protected their homes by surrounding them with walls of earth and stone. In some of these mounds specimens of various kinds of pottery, in a perfect state of preservation, have from time to time been found, and fragments are so common that every student of archæology can have a bountiful supply.

"Some of these fragments indicate vessels of very great size. At the Saline Springs of Gallatin County, Ill., I picked up fragments that indicated, by their curvature, vessels five to six feet in diameter, and it is probable that they are fragments of artificial stone pans used to hold brine that was manufactured into salt by solar evaporation.

"Now, all the pottery belonging to the Mound-Builders' age which I have seen is composed of alluvial clay and sand or a mixture of the former with pulverized fresh water shells.

"A paste of such a mixture possesses in a high degree the properties of hydraulic pozzuolana and Portland cement, so that vessels formed of it hardened without being burnt, as is customary with modern pottery. The fragments of shells served the purpose of gravel or fragments of stone as at present used in connection with hydraulic lime in the manufacture of artificial stone.

"It will be seen by the following analysis of a piece of ancient pottery from the 'Bone Bank,' in Posey County, Indiana, that, so far as chemical constituents are concerned, it agrees very well with the composition of hydraulic stones.

"ANCIENT POTTERY, 'BONE BANK,' POSEY COUNTY, IND.

Moisture at 212° F.	1.00
Silica	36.00
Carbonate of lime	25.50
Carbonate of magnesia	3.20
Alumina	5.00
Peroxide of iron	5.50
Sulphuric acid	0.20
Organic matter, alkalies, and loss	23.60
Total	100.00

"It is my opinion, based upon the result of its analysis, that it is simply an artificial stone made from a mixture of river mud and pulverized fresh water shells. Instead of softening in water, as they would if made of clay alone, the shells give to the composition hydraulic properties, and vessels made of it harden on exposure to air and moisture. When filled with water and meat, pots made of this material could be placed over the fire and heated without fear of breaking them.

"Those ancient artisans must have been aware of the advantage derived from a thin body to resist breakage from expansion and contraction from the heat of the fire.

"I have a beautiful vessel from the 'Bone Bank,' made of artificial stone, which has ears, and is otherwise formed like an old-fashioned cast-iron dinner pot. It is five inches across the mouth, and seven inches in diameter at the bulge, five inches deep, and only one eighth of an inch thick. The bottom is smoked black, which goes to show that it was suspended over the fire for cooking purposes."

It will be noted that Prof. Cox describes the lime and magnesia as carbonates, and states that they are in the form of pulverized shells, and so used in the mixture, while Dr. Wallace takes the position that the lime was calcined and subsequently became carbonated.

By giving the carbonic acid its full equivalents of lime and magnesia to form carbonates of those bases, and the sulphuric acid its full equivalent of lime to form sulphate of lime, in the mortar from the temple at Pentelicus, as given by Dr. Wallace, it will be found that the excess of lime is so slight as to preclude the belief that the lime was calcined prior to its use, and that the position taken by Prof. Cox is the correct one, and it is not difficult to believe that in all these ancient mortars named, pulverized carbonate of lime was the cementing agent used.

The "Old Stone Mill" at Newport, Rhode Island, which, according to many learned antiquaries, was built by the Norsemen five hundred years before the landing of Columbus, was constructed with a mortar composed of pulverized shells, clay, sharp sand, and fine gravel.

The antiquity of this ancient structure has been a subject of much discussion.

J. P. MacLean, in *American Antiquarian*, stoutly maintains that it was built by or upon the lands of Gov. Benedict Arnold during the period of his residence at Newport, which was from 1653 until his death in 1678.

Mr. MacLean states that in the year 1848 some mortar taken from an old stone house in Spring Street, built by Henry Bull in 1639 (the year in which Newport was founded), some from the tomb of Governor Arnold, and some from various other buildings was compared with the mortar of the Old Mill, and found to be identical in quality and character.

Whether the Old Mill has been built more than nine hundred or only a little over two hundred years, the fact remains that the mortar with which it was constructed is composed of the materials as stated, and a careful examination of this structure, by the writer, during the summer of 1894, revealed some curious features which are not easily adjusted to modern ideas of stability.

The stones are mostly small and unshapen, and in many places the mortar joints are over an inch in thickness. Taken altogether, the work was carelessly done, and how such a wall could have been held in place for even two hundred years with such a mortar, and in such a climate, seems almost incredible. There are no indications of crumbling on the part of this curious mortar; on the contrary, it is hard and firm, and from present appearances is liable to remain so for centuries to come. The fact will not be overlooked that this mortar is composed of identically the same materials as are those mentioned by Prof. Cox as having been used by the Mound-Builders, which fact is rather damaging to the theory adduced by Mr. MacLean in his attempt to overthrow the arguments advanced favoring the antiquity of the "Old Stone Mill."

It would be a rash man who, to-day, would build a structure of any importance with a mortar composed of pulverized shell, marl, clay, and sand; and yet, with the evidence before us of its having been so used in the "Old Stone Mill" in New England, where it has been subjected to alternate freezing and thawing through all these years, and even accepting Mr. MacLean's theory as to the time which has elapsed since its construction, it antedates by a full hundred years the time when Smeaton "lightened up the darkness surrounding the subject of mortars and their behavior under varied circumstances," it would seem that the permanence and durability of shell-lime, *i.e.*, carbonate of lime, mortar must be conceded.

But it is not at all clear how a mortar composed of such materials can, without calcination, become hard. It is quite true, as stated by Prof. Cox in his reference to the analysis of ancient pottery, that "so far as chemical constituents are concerned, it agrees very well with the composition of hydraulic stones;" yet this does not by any means constitute an hydraulic cement, which, it may be inferred, was meant by him where he states that "a paste made from such a mixture possesses in a high degree the properties of hydraulic pozzuolana and Portland cement, so that vessels formed of it hardened without being burnt, as is customary with modern pottery."

It is true that Portland cement is made by an admixture of clay and carbonate of lime; yet, however thoroughly and intimately these two ingredients may be commingled, it is clear to every one who is at all familiar with the subject that this mixture, without further treatment beyond its mere mechanical incorporation, cannot be induced to harden beyond a natural moderate hardness due to the drying out of the clay.

By submersion it soon becomes plastic again. At such a stage, and in such a condition, there is no chemical affinity between these substances.

There are present two acids and two bases. Each of the former is chemically combined with one of the latter, in certain fixed proportions.

The lime is combined with 78.57 per cent. of its own weight of carbonic acid, which in hundred parts is lime 56, carbonic acid 44 = 100 carbonate of lime.

But clay is rarely found in true combining proportions, the silicic acid almost universally predominating. The latter combines with nearly 57 per cent. of its own weight of alumina.

The ratio in one hundred parts being silicic acid 63.83 and alumina 36.17 = 100 silicate of alumina.

In the analysis given by Prof. Cox, the silica is 36.00 and the alumina is 5.00. Therefore, as the 5.00 of alumina will combine with only 8.82 of the silica, forming clay 13.82, there must necessarily remain 27.18 of free and uncombined silicic acid, and this cannot combine with the lime, which already has its full equivalent of acid; and although the latter is volatile, it will not part from its combination with the lime, except through the agency of heat, even though the carbonate of lime is in intimate contact with free silicic acid through countless centuries, as is shown in the natural cement rocks throughout the world, nearly, if not all of which contain more silica than will combine with the alumina present, and which in no manner affects the relative proportions of the constituent parts of the carbonate of lime. (*To be continued.*)

VARIOUS SYSTEMS OF CONCRETE CONSTRUCTION.

CONTINUED FROM APRIL NUMBER.

CONCRETE AND TWISTED STEEL.

RANSOME SYSTEM.

THE essential idea concerning the use of twisted steel and concrete is that the resulting construction is a beam and not an arch. This at once gives it a field of its own, and sets it apart from all other systems involving the use of steel, for invariably, in all other practical results, the arch is the basis of the structure. In the Melan system, the principle used is the arch, although the economy with which iron is used in the construction renders the system exceedingly valuable from a practical standpoint. This system is essentially adapted to bridge construction, while the Ransome system is of greater value in floors, girders, and flat structures.

The manner of calculating the proportions of a concrete beam has already been described.

The sectional area of the tension bar is determined in the same manner as the flange of an I beam. The sectional area of the concrete in the upper third must be at least fifty times the area of the tension rod.

The concrete should be composed of good materials, that is, of a cement of requisite strength and fineness, and of small aggregates consisting of any of the following, which are named in order of merit: hard limestone rock, hard burned brick or broken pottery, granite or basalt, hard clinker, broken flint or other hard rock, gravel. Care should be taken to use only clean materials, free from dust or impurity of any kind. The aggregates should be broken to pass through a 1 in. mesh, and all fine dust removed. The mixing should be thoroughly done, and sufficient water added to bring into the condition of stiff, tenacious mortar.

"It is of vital importance for the strength of the structure that the iron bars be placed no higher in the beam than calculated for; that the longitudinal center of these bars should be at the lowest point, and it is advisable that the bars curve upward slightly and uniformly each way from the center to the ends, so that the ends are from 1 to 2 ins. higher than the center. No crooked or irregularly twisted bar should be used; otherwise there is danger of straightening and consequent fracture in the beam." A bed of concrete is first laid and the bar placed in the requisite position; then the balance of the concrete is put in place, so as to form one solid homogeneous mass.

The most economical spacing for beams is about 27 in. centers. Where the beams are farther apart, as they readily may be, even as much as 15 or 20 ft., small rods should be run at frequent intervals through the top layer, running at right angles to the beam.

The sizes of beams for different bars are given below:—

For ½ in. bars, the beams should be 1½ in. thickness and 25½ in. on centers.
,, ¾ ,, ,, ,, ,, ,, ,, 2¼ ,, ,, ,, 26½ ,, ,, ,,
,, 1 ,, ,, ,, ,, ,, ,, 3 ,, ,, ,, 27 ,, ,, ,,
,, 1¼ ,, ,, ,, ,, ,, ,, 3¾ ,, ,, ,, 27¾ ,, ,, ,,
,, 1½ ,, ,, ,, ,, ,, ,, 4½ ,, ,, ,, 28½ ,, ,, ,,

Bars larger than 1½ ins. are rarely used.

For spans up to 25 ft. the following are the proper dimensions of beams. "Thickness" refers to the size of the upper third, or compression area, and "Depth" to the distance from the top of the beam to the center of the bar.

SPAN 10 FT.

Safe load in pounds per square foot.	Approximate weight of floor in pounds per square foot.	Size of Twisted bar in inches square.	Thickness of upper third of concrete in inches.	Depth in inches from top of beams to center of bar.
50	17	½	1	6.
125	24	¾	1¼	6.
250	35	1	2	6.75
500	44	1	2	12.75
SPAN 15 FT.				
50	24	¾	1¼	6.
125	26	¾	1¼	7.75
250	44	1	2	12.75
500	62	1¼	3	16.25
SPAN 20 FT.				
50	29	¾	1¼	10.75
125	45	1	2	13.25
250	62	1¼	3	16.
500	97	1¾	5¼	16.25
SPAN 25 FT.				
50	41	1	2	10.75
125	60	1¼	3	15.
250	83	1½	4	19.
500	126	2	6¾	20.75

The floors in the Pacific Borax Company's warehouse in Alameda, Cal., are of 20 ft. span, built for 200 lbs. safe load, and of section approximately as above; and they have been loaded repeatedly with excessive weights, sometimes as high as 550 lbs. per square foot with a deflection of only 3/16 of an inch.

The floors in the Academy of Sciences in San Francisco were loaded when only a month old with 480 lbs. per square foot; span, 22 ft.; bay, 15 ft.; deflection, ⅛ in.

A specimen beam, 17 ft. long, recently sustained a load of 1,060 lbs. per foot with a deflection of 3/16 of an inch. Final fracture after three days was due not to the load, but to the undermining by rains of the pier on which one end of the beam rested.

Many other tests of the actual working value of the construction are on record, and, to the writer's knowledge, there has never been an instance of failure of any kind, although the tests have been extreme ones.

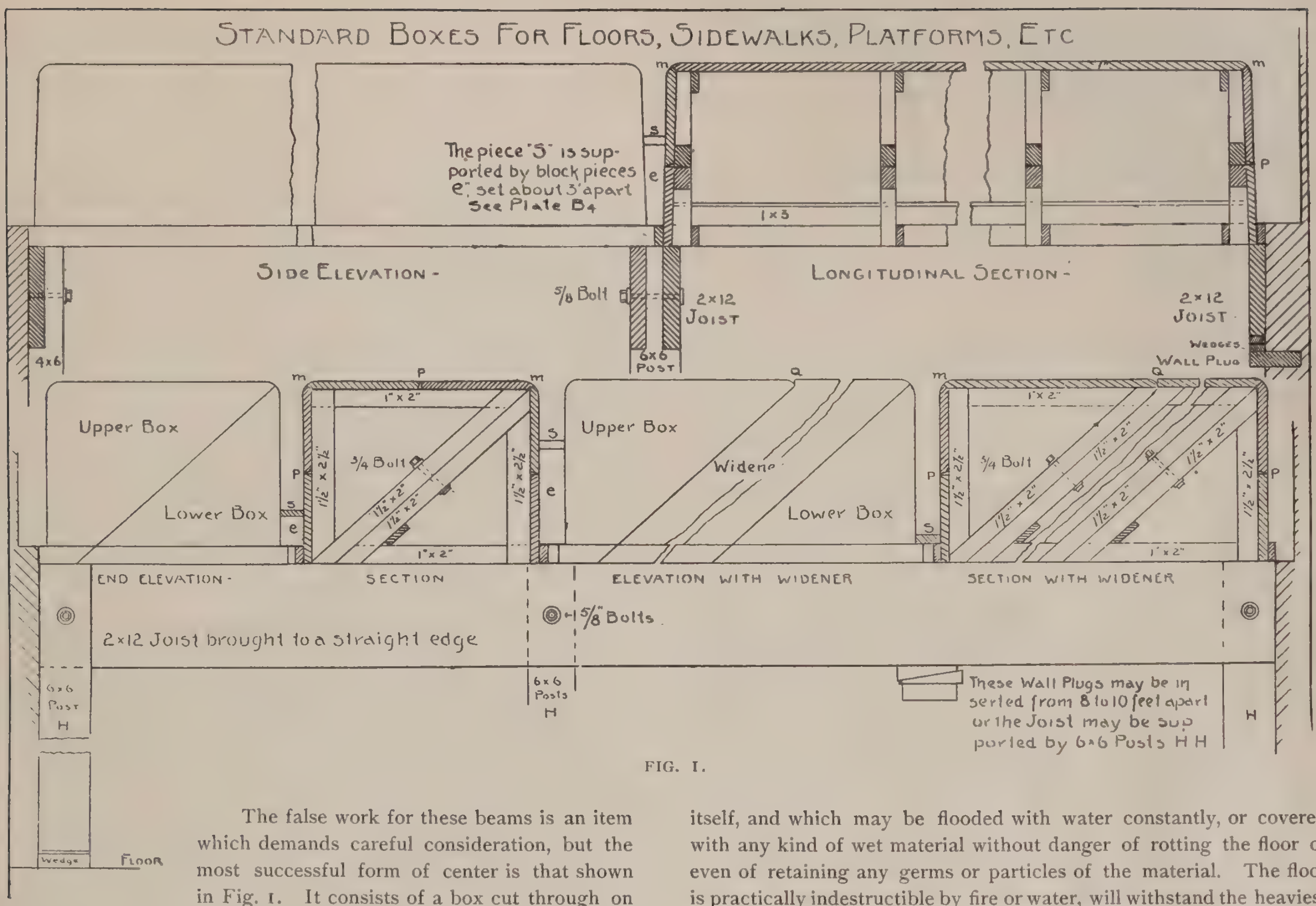


FIG. I.

The false work for these beams is an item which demands careful consideration, but the most successful form of center is that shown in Fig. 1. It consists of a box cut through on a diagonal in such a manner that the two parts may be locked together and set in place, and after the concrete is properly hardened, the lower half of the box is detached, and then the upper half is readily taken out. This center may be used continuously and the expense of centering thereby greatly reduced.

The chief difficulty encountered in constructing centers for concrete, especially in caissons, panels, etc., is in the swelling and binding of the wood, requiring everything to be cut on a bevel and necessitating much waste in stock and labor. This is largely overcome in the device spoken of.

In a number of ways flat ceilings may be made, and then the floor is hollow and has all the advantages accruing from that feature. A key may be made on the lower edge of the beam and a slab of concrete, staff, or other material set upon these keys and plastered. Mr. Ransome recommends making these slabs in place of plaster or cement, but sometimes this is not feasible on account of the lack of depth in the beam, notably in small spans. The most satisfactory method, at least for small spans, seems to be in embedding wire in the concrete about 3 ins. on centers, passing in a loop over the bar, leaving the ends protruding. Wire lath, expanded metal, or other similar material may then be readily fastened to these wires and the plaster coat put in place.

For dwelling-houses, office buildings, hospitals, asylums, and that class of buildings, a very pretty paneled effect may be produced by using the beams and the flat floor filling, a panel 16 ft. by 20 ft. being easily constructed. By using the ordinary beam spacing and the flat ceiling, the results attained in the ordinary fire-proof floor are reproduced in a very superior fashion. For the wearing surface, mosaic, tile, wood flooring of various kinds are most popular in light floors, and the great rigidity of the concrete beam gives the floor many advantages over the steel beam in the matter of deflections. For breweries, malt houses, packing houses, and similar structures there is no better floor in existence, for the concrete may be finished with a hard wearing granolithic face which is a part of the floor itself, and which may be flooded with water constantly, or covered with any kind of wet material without danger of rotting the floor or even of retaining any germs or particles of the material. The floor is practically indestructible by fire or water, will withstand the heaviest traffic and wear, is exceedingly strong, besides being inexpensive and readily adaptable to any building, and easy and quickly constructed.

In a subsequent paper some methods of attaching a wood top to a concrete floor will be described.

ROSS F. TUCKER.

CHICAGO, ILL., July 1, 1895.

PUBLISHERS OF THE BRICKBUILDER:

Gentlemen, — Several weeks ago I explained to your representative the difficulty of securing durable outside plaster or cement "rough cast" either in plain surfaces or with half timber work. He suggested that I write you and endeavor to call out a full discussion of outside plaster work which is in line with your most valuable papers on cements and mortars. There seems to be many different opinions as to the best method to follow for combined durability and effect; some, including one of our most eminent practical architects, advocating pure lime mortar with long hair or fibre, and others claiming that only pure cement mortar on metal lath or "expanded metal" can be relied upon. On a half-timbered country house built a year ago, I used lime sand and hair mortar on metal lath for the first coat, and cement and sand (one to one) for the second coat after the first had hardened for some time; the mortar and hair taking a strong "clinch" in the metal lath, and the cement forming a thin, extremely hard protecting "skin" over the first coat. I should say that the work would be much better if the first coat were left uncovered for four or five weeks at least, in order to harden under atmospheric action, but so far this piece of work seems successful. As a number of us younger men in Chicago have a strong liking for plaster externally in connection with brick and timber, I am sure that many of your readers would be very much pleased to find in your columns a discussion by those who are especially informed in this rather unusual direction. Hoping, personally, that others will give both theories and practical experiences, both as to English and American practise, I remain,

Yours sincerely, R. C. S., JR.

The Mason Contractors' Department.

Conducted in the Interests of the Builder and the Contractor for Brickwork.

CONSTRUCTION OF HIGH BUILDINGS.

AS the land in the center of large cities becomes very much advanced in price and becomes exceedingly valuable, and the space to be roofed in is absolutely limited by our neighbors' land and the lines of streets, while there is a demand for yet more space than can be obtained by the ordinary methods and plans, the only thing to do is *to go higher*. This custom is observed by almost every intelligent traveler; as he passes through a given city he finds all the buildings six or eight stories high in the center of the city, and as he passes along the suburbs sees nothing but two or three story structures, for on the outskirts land is cheap and plenty, and is a temptation for a man to spread out and fence in all he can get hold of for his individual use and enjoyment; but the owner of the lot in the center considers himself rich if he owns but one lot, and sets himself about its improvement by pulling down the small building and building greater, higher, if possible, than his neighbors were willing to go.

Indeed, it seems at times as if the same spirit which actuated the building of the Tower of Babel is again abroad in the land; and yet, high as they built, there is no record of the walls or any part of the foundations giving away under them. They had no architect; if they had, his name has not been handed down to us. It appears, as far as we can learn, that they lost the power of intelligent language among them, and just as soon as the age of high building comes in this country there comes also such a diversity of language on them that it is no rare thing for an interpreter to be constantly employed to give in language the men can understand directions how to build.

High building has also brought about a complete change in the manner of raising the material to the dizzy height at which it is to be built into the walls. Many men who read this paper can readily remember when the first steam engine was called into use for this purpose; indeed, it is not over a dozen years ago that the price of high party walls was reduced to the same as lower walls, simply because such high buildings can now be erected with these new facilities as cheaply as low buildings.

As these very high buildings in a given square increase, the objectionable character of the upper stories is in the same ratio decreased; for it is exceedingly offensive, while occupying, say, a sixth story room, the window of which opens out over a chimney top of a cobbler whose only means of keeping a little warmth in his room is by burning his leather parings, which sends up such a cloud of offensive smoke as to render such a room almost uninhabitable except with closed windows. So much is the tenant of such a high room annoyed that he gives notice to his landlord that unless this most intolerable nuisance is abated he will be compelled to vacate. So the landlord sets about getting his lowly neighbor to raise his chimney, when he finds out for the first time that he did his best to induce the bricklayer who built these high walls to raise his chimneys at the same time, but he refused unless he was paid beforehand for doing it; and on conversing with his bricklayer he also learns from him the difficulties of raising a neighbor's chimney; and the result is that every architect of sound judgment now carries up in his plans his neighbor's chimneys, in order to strengthen his building, and to save his future tenants this annoyance, and so increase the demand for the upper stories.

I believe it was De Quincy who was asked why he lived in the sixth story of the Scotch town where he dwelt, and his reply was, "Because I cannot get a seventh story." He had found it an excellent hiding-place from boring callers, and he got plenty of light.

The chief advantage, perhaps, and which at first prompted high building, apart from the question of increased room which it enabled one to roof in, was the advantage of a cheap ground rent for the square foot of habitation thus so largely increased.

Yet a certain English writer has labored hard to show that the largely increased price of high buildings necessitated by the exceedingly broad and deep foundations and of the extraordinary skill and care required, make these cost a much larger sum than otherwise, and also the extra thickness of the walls above. Indeed, he says, a certain London architect could not get large enough foundations, though he had covered the entire lot, the lot being 50 ft. front, and each foundation being 26 ft. wide. More land had to be bought on which to rest the foundations; therefore, this writer advises more buildings of less height, thus forgetting entirely the fact that there is no more land to be had at that spot; it is all taken and highly prized and the owner refuses to part with it except at a higher figure than it will cost him to go up, up, up, six, eight, ten, twelve, fourteen, aye, twenty stories!

I have referred briefly to the fact that high buildings had *come* and come to stay. This fact becomes more evident when we remember that the steam hydraulic elevator places all the stories on the first floor. No one has any doubt but that the number of these high buildings will be largely increased within the next few years.

It seems that, differ as we may as to every other point about high buildings, we all agree upon *one* point and it is this: That brick is the most desirable because the most fit material with which to construct the walls of high buildings for the following plain reasons, apparent to every practical mind:

First: Because so easily and cheaply obtained.

Second: Because brick is so very durable.

Third: Because so easily ornamented.

Fourth: Because it will not split and sprawl in case of fire, as will other material.

Fifth: Because so readily procured in almost any shape and color and in any quantities in almost every locality.

A close and critical examination of some of the large buildings in this country recently erected reveals an alarming degree of malconstruction, so that in some cases the strength is not only very much impaired, but the beauty considerably marred, if not entirely destroyed. I use the word "malconstruction" not unadvisedly, for it has been fully demonstrated, since a certain building in New York City was built, that *it is possible* to build walls no thicker, but very much higher and with wider span than that building has and make them perfectly secure. You must not simply veneer the outside face with a four-inch press brick driven down to a close, tight, hard joint, and then fill in behind eighteen inches thick with old bats and coarse mortar of half-inch joint; then at several intervals in a story tie this indifferent slouch work to the outer veneer, so that when four or five stories are reached the walls begin to settle down and the entire weight of the floors is thrown on the outside four-inch veneer, which was well calculated to carry 4,000 lbs. to the square inch, but not intended to carry 35,000 lbs. to the square inch, for its ultimate strength is not over 8,000 lbs. The result is readily seen. The press brick is crushed to powder and blown away by every passing breeze.

In striking contrast to this, we find such buildings as the Produce Exchange Building, New York, the walls standing straight and strong, no crushing or bulging. Everything about the walls shows the possibility of high grade mechanical ability.

Many other high buildings in all cities show equal strength. No sign of a crushed or even cracked brick or unequal settlement visible in any part of the building; these are all monuments to the memory of the builders; while the one crumbles and falls, the other stands firm and solid, and goes down the ages reflecting credit and praises to the builders.

Did the illustrious architect of St. Peter's at Rome have any doubt of the strength or stability of any of its parts? Did he not make numerous and exhaustive experiments of every part of that immense pile before the workmen began?

Having modeled and tested every timber, wall, and beam, he was enabled to determine the strength and resistance of each to the other.

Suppose the illustrious sculptors who so successfully placed so much highly artistic ornamental work in every part of our Columbian World's Fair should have failed to measure, and mold, and magnify to their proper proportions and suitable strength every limb and ligament of those studied, stately statues. Suppose the shoulder of one to be so small as to be utterly unable to support the arm of disproportionate size and weight. Or, suppose the neck of another should be altogether too slender and long for the big head he had happened to hang thereon, would it be a sufficient answer if he should say: Wait till the next World's Fair you have; then I shall be better able to judge of these things? Then let us builders who are ever engaged in beautifying our cities and towns scorn to do a mean piece of work, to have the architect change it, but, rather, help on the fast-growing opinion that no man can become an efficient architect who is not a practical mechanic.

A Brickbuilder.

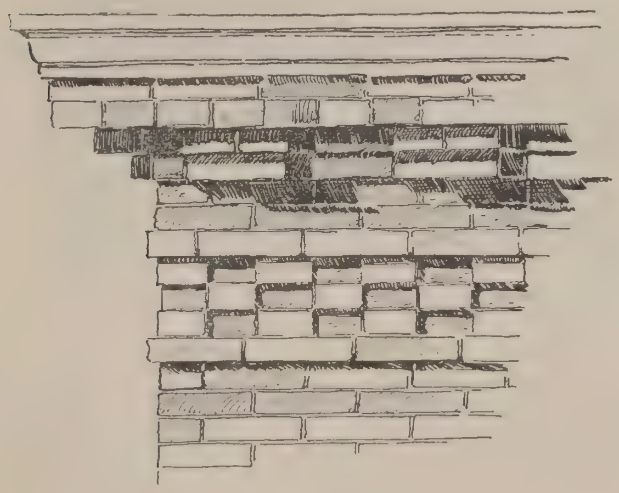
THE DETAIL OF CHEAP HOUSES.

THERE can be no definite rules given for the adornment of brick cottages, or, in fact, of anything else; for that which may be correctly applied in one case is generally entirely out of place in another.

There are, however, some points which, used with intelligence by the builder, may help him to relieve the blank monotony characteristic of so many of his houses.

The cheaper classes of brick dwellings in this part of the country seem to be divided into two classes, the absolutely plain and those overloaded with detail. Now, while there are some buildings which by reason of their proportions are beautiful, or, at least, not offensive to the eye, the majority could be much improved by a little simple detail.

The builder, in the first case, puts up the cottage for the smallest amount possible and gives himself no trouble as to its appearance; in the second, having an allowance for ornamentation, he selects from some book a cornice or a frieze, and, working out its construction, builds it in without thinking that, while it may be appropriate on an Italian villa, it is out of place and "bad" when looked upon as detail for a workingman's cottage.

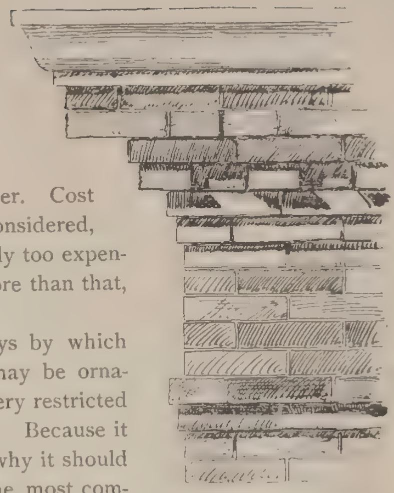


It is the middle course which is necessary to good brickwork in cheap houses.

The idea of ornament, so far as we are concerned at present, at all events, is not so much to attract attention to this or that particular part, but to break up the surfaces, to soften the hard lines of the building, to strengthen in appearance parts seeming weak, and to tie the whole together into an agreeable mass.

The *simpler* the way by which this is done, the better. Cost is the principal thing to be considered, and elaborate detail is not only too expensive, but unnecessary; no, more than that, — objectionable.

There are plenty of ways by which an ordinary brick cottage may be ornamented at a cost within the very restricted limits of a "cheap dwelling." Because it must be cheap is no reason why it should be ugly; with nothing but the most common materials in the market, effects may be gained rivaling those of twenty times their cost.



LEGAL POINTERS.

A stockholder of a corporation is entitled to have his attorney and stenographer accompany and aid him when he desires to examine its books.

Liability of Independent Contractor. A person who has hired a contractor to do certain work and has no immediate control over the servants of the contractor is not liable to a person injured through the negligence of one of such servants.— *Supreme Court of Michigan.*

Liability of Contractor's Bond. Where a building contractor abandons the work before it is completed and absconds, the guarantor of his contract, who elects to treat the failure and flight of his principal as settled facts and to cooperate with the owner in completing the work, becomes liable as surety.— *Supreme Court of Pennsylvania.*

Right of Adjoining Owner in Overhanging Wall. The Supreme Court of New York, First Department, holds that where the owner of a lot erects a wall the foundation of which is wholly on his lot, but a part of which overhangs an adjoining lot, the adjoining owner will not be enjoined from removing so much of the wall as overhangs his property.

Right to Mechanic's Lien for Improvements. Where a lease provides that the lessee may, at his own expense, alter and repair the building, one who makes the alterations under a contract with the lessee does the work "with the consent of the owner," within the statute providing who may acquire a mechanic's lien. Where improvements become part of a building, the fact that they were designed specially for the tenants' business will not affect the right of the person doing the work to a mechanic's lien.

Construction of Building Stone Contract. A party offered to furnish another with building stone at $6.00 per cord, and the latter replied that he "would do better than that," and pay $6.50 per cord, measured in the wall. Both parties were experienced in the business, and knew that a cord of rough stone (128 ft.) makes only 99 cu. ft. of masonry. The Supreme Court of New York, Oswego County, held that it was the intention of the parties that the stone should be measured in the wall at the rate of 99 cu. ft. per cord.

Mechanic's Lien — Bond of Owner. A bond given by the owner of buildings upon which a notice of lien for materials and labor has been filed, conditioned for the payment of any judgment that may be rendered against the property (as provided by the laws of New York, and some other States), takes the place of the property, and discharges and becomes the subject of the lien; and an action is maintainable upon the bond against all parties interested, including the sureties, without first foreclosing the lien upon the property. — *Court of Appeals, New Jersey.*

Recent Brick and Terra-Cotta Work in American Cities.

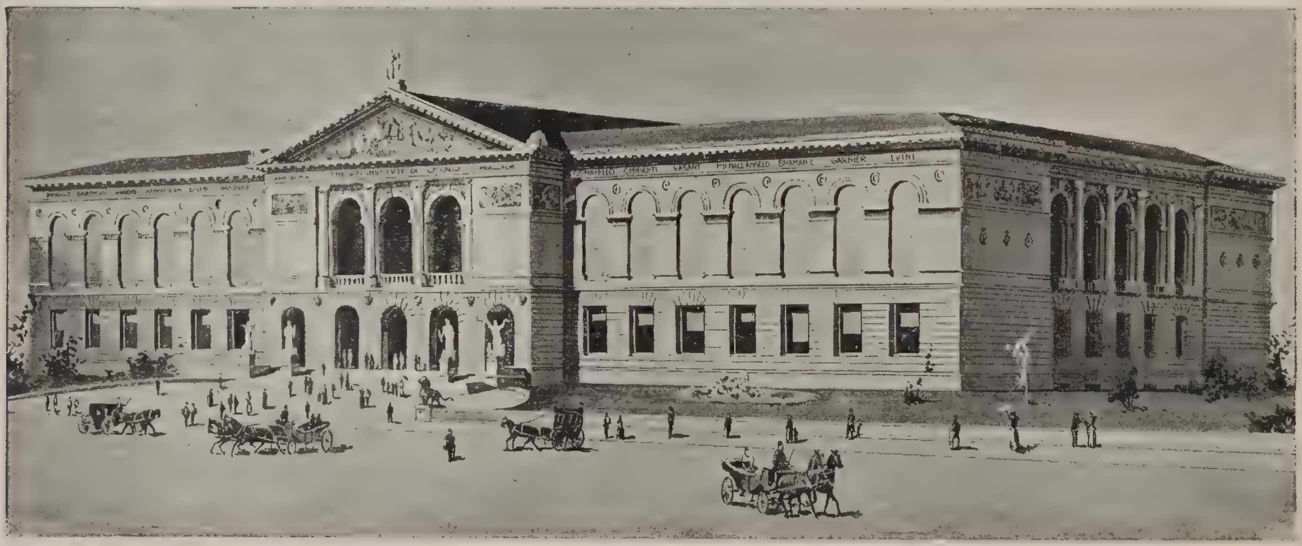
A Department Devoted to the Interests of the Manufacturer.

CHICAGO. — It seems like old times again in Chicago to look down into a great hole in the ground and see all the foundations in place for an office building, and the silent, deserted cast-iron stools waiting for the columns to rear their heads. Delay in furnishing steel after the dull period comes like a surprise. Manufacturers seem to have been flooded with orders all at once, so that now one finds his order, if accepted at all, on the file for some months ahead.

If it is true that the boom in steel is due to a demand for building purposes largely, it must be from smaller cities which have taken the office building mania; certainly Chicago is using, at present, comparatively but a small amount in large buildings. However, we must not forget that large all steel construction buildings use but a fraction of the amount of metal used in small buildings which have only a few girders or store front beams.

The foundations for the Atwood office building are in place, ready for the basement columns. The general contract is in the hands of the Geo. A. Fuller Company.

The ground is being excavated for the Winnebago eighteen-story office building, D. H. Burnham & Co., architects. The Guaranty Construction Company, 713 Medinah Temple, have the general contract.



ART INSTITUTE BUILDING, CHICAGO.

Shepley, Rutan & Coolidge, Architects.

Another large apartment building is projected. Its picture has been published in the daily papers, and the statement made that its nearly seven hundred rooms will be soon in course of construction. Jul de Horvath is the architect.

A matter of considerable interest to architects and physicians has occurred lately in connection with a new hospital for small-pox, planned by the city of Chicago. The buildings, twenty-five in number, were expected to cost about $200,000. Working drawings had been completed and the principal contract let for $125,000, by the administration which has lately gone out of power. Construction of the foundations was well advanced when discovery of defective work led to a suspension of operations. Then a desire by the new municipal administration to decrease the cost of the institution led to an investigation by a committee of physicians, headed by Dr. Hamilton of the United States Marine Hospital Service. They reported that the buildings as planned would accommodate only one hundred patients, and, being spread in a scattering fashion on ten acres of ground, would be exceedingly expensive in administration. They recommended as a substitute (also on the pavilion plan, but more compact in arrangement) a scheme in which the buildings of administration should form a central group, and be made of permanent fire-proof construction; and provision be made for building any number of separate wards, as necessity might demand; these to be of cheap construction for easy destruction.

The Board of Health is making elaborate provision for vaccinating the population, expecting thereby to have less need in future than in the past for a large small-pox hospital.

There ought to be a great school of architecture in the central part of our country. For the cause of good architecture, we are glad to note that Chicago, with her two million inhabitants, has made a good beginning, and ambitious western students, when they find Boston Technology, or Columbia, or Cornell beyond them, are turning to the Art Institute; and if the progressive ideas of the chief patron of this institution, Mr. Chas. L. Hutchison, and the director, Mr. W. M. R. French, are any indication, the school of architecture in Chicago ought soon to equal the best.

The alliance between the Art Institute and the Armour Institute supplies, on the one side, the home and atmosphere of pure art, and, on the other, the necessary training in the technical arts.

The exhibition of students' work this year is a surprise, even to Chicago architects.

Aside from the plans and elevations of the usual fabulously expensive palaces and museums rendered in French academic style there are many well-done plates of "orders," shades, and shadows, perspectives, wash and water-color work, done after the system in vogue in Columbia. The neat sheets, showing graphic analysis and truss details, argue that construction is receiving due attention along with the artistic designing.

Among the staff of instructors and lecturers on architecture, the genius of Mr. Louis J. Millet is doing much to build up the school. His classes in original design show some remarkable work, although some might criticize their being too entirely "Sullivanesque" in style. The designs are carried into the "Room of Application" and very instructive work done in modeled ornament. Capital, spandrels, polychromatic friezes (reminders of the Transportation Building at the Fair) are modeled in clay, and even mosaic work is designed and executed by the young architects.

The magnificent new Art Institute building, designed by Shepley, Rutan & Coolidge, and the splendidly equipped Armour Institute together should make a home for a great school of architecture. May it exert a powerful influence on the architecture of the West.

PHILADELPHIA. — Within the few years just passed several of the best architects of this city have made some brilliant successes in the use of the common "run of kiln" bricks. In many instances these were used inclusive of the blackened arch bricks, and even in some instances of the greater proportion of the darker material, the lighter and more regularly burned being excluded. These architects understood their business, however, and designed for the materials they were to use; the result has been a pronounced success, as is shown by the imitations which are being thrust upon the public by those less skilled in the use of the material; indeed, it has taken the fancy of the public to such an extent that demands have been made upon the speculative builder for dwellings of this material; and the builder has seized with eagerness the opportunity thus given him to use the cheaper material for his fronts and charge more for the job than if he had used the best quality of pressed bricks. He argues that of course the fronts are very "artistic," and if the people want them this way they must pay for it. The public in general would not suffer from this transaction, were it not for the fact that within the scope of the "artistic" are some of the meanest and most despicable designs (if they may be called by that name) that have ever been executed in this city, renowned for its bad architecture. There was at least a certain neatness in the brick and marble fronts which had previously been built, even if their detail was of the worst and their composition empty and monotonous; but this only qualification is lacking in the "artistic" fronts, while the would-be Italian balconies, executed in galvanized iron and shingles, and the ever-present and badly proportioned loggia of the same order, combine to make this latest acquisition to Philadelphia architecture the worst that it has ever seen. Happily, however, there is arising in the city a class of architects who have been well educated into the principles of the profession, who are not merely plan machines, and whose offices are not plan factories; better still is the fact that these architects have been receiving and executing commissions from the best classes of clients, and are thus able to show the public the real difference between that which really is artistic and the other thing. Any number of good architects, with no commissions to execute, would be powerless to educate a community which can be educated, artistically, only through the sense of sight; it is, therefore, very gratifying to note that their works are being duly appreciated, and that the time is quickly approaching when the word "artistic" will have to mean something more than showy or glaring. We are beginning to fear that the time is approaching for some persons to retire from business.

St. James Hall, which will shortly be given into the hands of the contractors, will add another to the fine terra-cotta buildings of the city. It will be situated at the corner of Thirty-Eighth and Market Streets, and will be for the use of the St. James Parish. The first floor contains the necessary entrance lobbies and four storerooms fronting on Market Street; the second, a large assembly hall and the necessary anterooms; the third has rooms for the meetings of the societies connected with the parish, reading, chess, and billiard rooms, and smaller rooms for the meetings of special committees. The entire fourth floor is given over for use as a gymnasium, to which is attached lavatories, baths, and showers for the use of the members; and a wide balcony, forming the fifth floor, will be used as a running track. The exterior is in the style of the French Renaissance, is quite rich in detail and very liberally ornamented with terra-cotta and diaper patterns in brick. The architects, Messrs. Rankin & Kellogg, have devoted very much study to the various parts of the work, and especially the designing of it, and have succeeded in producing a building of which they may well feel proud.

A final scheme for the new Museum of Archæology, which will be built in the near future, has been adopted, and the architects are busy with the working drawings. The building will be very large and will rival anything of a similar nature in the country. The architects who have been commissioned for the work are three well-known firms,— Wilson Eyre, Jr., Frank Miles Day & Bro., and Cope & Stewardson. We expect to be able to give the details of the operation in the near future.

Under the date of June 3, 1895, the Master Stone Cutters' Association of this city have issued the following: "At a regular stated meeting of the Master Stone Cutters' Association held this evening, the following resolution was adopted: *Resolved*, That we will not estimate on any job of cut stone work that is a less scale than one fourth of an inch to one foot, and the secretary be directed to notify all architects in Philadelphia and vicinity."

Quite a suicidal policy to adopt just at the time when there is a great deal of very large work upon the markets and the terra-cotta companies are pushing their material against cut stone whenever an opportunity presents itself.

Plans are being prepared by Architect Huston for the ten-story publication house and office building for the Presbyterian Publication Society. It will cover an area of 75 x 235 ft., and will be located on the corner of Walnut and Juniper Streets.

PITTSBURG. — Building is very lively at present, as there is talk of a rise in prices on materials, which most of the investors are taking advantage of; although many business rooms and houses are vacant, many new operations are under way.

Ground will be broken at once for the new family hotel to be erected on Fifth Avenue, from Neville to Craig Streets, costing $2,000,000. The building is to be of fire-brick and red terra-cotta trimmings in Spanish style of architecture.

Mr. G. D. Simen has plans well under way for a large store and office building to be erected on Grant Street. It will be twelve stories high, and it is intended that this shall be the most imposing structure on the street.

Architect S. A. Barr has plans for a seven-story stone and brick office building to be erected in the East End; it is to have all modern conveniences and a roof garden.

Architect J. E. Allison has plans for a brick and stone church to be erected at Venice, Washington Co., Pa.

According to report, McKeesport is to have another hotel, which will cost $500,000 or more. A Pittsburg capitalist is interested in the scheme.

A new building ordinance was introduced into councils last week. It is one prepared by a committee, consisting of councilmen, architects, contractors, the building inspector, and the fire marshal. The ordinance applies to all buildings, except churches, hereafter to be built in the city over 60 ft. in height, measuring from the curb opposite the center of principal front to the highest point of roof. They shall be constructed after the manner known as "slow burning and fire-proof construction."

The term "slow burning" applies to all buildings other than hotels, theaters, assembly rooms, schoolhouses, hospitals, tenements, and lodging-houses over 60 ft. and less than 90 ft. in height, and of wood, and prescribes the dimensions of the timber to be used in beams, girders, joists, floors, etc.

The term "fire-proof" applies to all buildings over 90 ft. in height and built of incombustible material,— terra-cotta, brick, plaster, or iron, or metal, lath and iron, concrete, or steel, — and specifies the thickness of the covering for the several materials.

After the passage of the ordinance it shall be unlawful to construct any schoolhouse or hospital over one story in height, hotel or lodging house containing over thirty sleeping-rooms, unless after the manner provided in the class known as fire-proof, and any building destroyed can only be rebuilt as so provided.

Regulations are made for elevators, moldings, partitions, stairways, roof, boiler-rooms, bulkheads, tanks, skylights, etc.

BUFFALO.—There have been remarkable changes in the architectural history of Buffalo during the past year; not in the quantity of buildings erected, but the quality and vastness of the structures.

The daily papers have spread the impression of great activity here in building; this is quite erroneous, being principally real estate puffs and schemes, looking well upon the drawing-board, but not architectural realities.

The chief cause for the large buildings which are or have been erected is no doubt due to the expectations developed by the electric power at Niagara Falls.

Such investments are made principally by Eastern capitalists.

Below will be found mention of some of the larger buildings:—

Bank of Commerce: two stories; gray granite with red tile roof.

Delaware Baptist Church: cost $100,000; John H. Coxhead, architect; built of brown Medina sandstone.

Bank of Buffalo: R. W. Gibson, architect, New York; three stories; gray granite and cream terra-cotta, cornice and roof.

D. S. Morgan Building: cost $350,000; Green & Wicks, architects; twelve stories high; first two stories gray granite; remainder, gray brick, Sayre & Fisher make, with terra-cotta cornice and belt courses by Perth Amboy Company.

George B. Mathew: six stories; brick and steel store, in Flemish design, costing $90,000.

DETROIT.—Transactions in the building line have been very active, considering that the season is now well advanced into that period when business gives place to recreation and the volume of trade becomes lessened; still, notwithstanding that the month just passed was rather a quiet one in the architects' offices, Fire-Marshal Baxter this last week granted permits to the amount of a million dollars, being ten per cent. more than any previous week.

A few of the buildings which help to make up this favorable report are described below.

The Public Library, of which Detroit can well afford to be proud, is to have an extensive addition built of pressed brick and terra-cotta; this will make it a more comfortable and complete institution than that of any other city of the same size.

Wm. S. Joy is preparing plans for three elegant apartment houses, each to be six stories in height; up to the second floor will be bluestone, and the remaining stories of buff pressed brick.

The new Central High School building, designed by Architects Malcolmson & Higginbotham, is completed to the top of the basement windows.

Few enterprises have had a more trying career in development or a more satisfactory termination than the building of this high school.

The extreme dimensions of the building are: length, 307 ft.; depth, 232 ft. The total height is 233 ft., costing $400,000.

Plans have been commenced for several very important structures, which will be described in this column as soon as the drawings shall be sufficiently advanced.

COLUMBUS.—Yost & Packard report plans just completed for a new church edifice, to be known as the church of St. Francis. The structure will be of pressed brick with stone trimmings, designed in the Romanesque style, and will cost about $20,000.

Stribling & Co. report plans completed for an electric light plant and apartment house to be erected in this city. The foundations will be of Delaware Limestone, and the walls of terra-cotta brick from the Columbus Brick & Terra-cotta Co. The window architraves will be of gray molded brick.

The basement floor is to be given to the electric plant, and the three floors above will be divided into flats.

Messrs. Spielman & Elliott have dissolved partnership. Mr. Spielman will continue in the former offices of the firm, while Mr. Elliott will open an office in the Wheeler Building.

Mills & Goddard have completed plans for a fine residence for Mr. J. F. Dickinson. The building will be of pressed brick with bluestone trimmings. The plainness of the brick walls will be relieved by special details of ornamental brick patterns.

The same firm have completed drawings for a residence for Mr. J. H. Newton, of Newark, Ohio. The house will be built entirely of hollow tile of terra-cotta, all walls being thus made hollow. The wall ornamentation, window architraves, etc., will be of special molded terra-cotta forms. Even the foundation walls, porch foundations, and steps will be of terra-cotta. The main walls will be laid in broken range; the roof will be of terra-cotta tile. The interior of the house will be fitted with all modern conveniences.

AMERICAN ENAMELED BRICK.

IN view of the fact that enameled brick is coming rapidly into a much more general use in this country, we give herewith the results of tests made by Prof. Ira M. Woolson, Columbia College, New York, for the Pennsylvania Enameled Brick Co. This test is particularly important in view of the fact that if English size bricks are laid in the wall to the height of 100 ft., the lower courses in said wall are obliged to carry about 2,500 lbs.

EMERY HYDRAULIC TESTING MACHINE.

ENGINEERING DEPARTMENT, SCHOOL OF MINES, COLUMBIA COLLEGE, NEW YORK CITY.

Results of tests made for Pennsylvania Enameled Brick Co., Oaks, Pa., by Ira M. Woolson, E. M.

	Source	Pennsylvania.		
	Material	White glazed brick.		
	Test No.	1210	1211	1213
	How Tested	Pressure parallel to glazed surface.		
	Shape, Original	English size brick.		
	,, of test piece	Cube.	Cube.	Cube.
Dimensions:	Length or height in inches	1.888	1.880	1.875
	Diam. or breadth in inches	1.88	1.89	1.88
	Thickness in inches	1.89	1.87	1.87
	Area in square inches	3.55	3.53	3.51
	First Crack		15,808	
Stress in pounds. Compression.	Maximum on specimen	14,600	15,800	15,500
	,, per square inches	4,112	4,475	4,415

REMARKS.

No. 1210. Cracks came in body of the specimen. Glaze did not scale.

No. 1211. About ½ sq. in. of glaze flew off at 15,800 (first crack). After crushing, glaze adhered to broken fragments. In no case did glaze crack off until specimen failed.

This company, which is one of the largest manufacturers of American Enameled Brick, has, since 1891, sold more than 6,000,000 bricks. Some of the more prominent jobs that we call to mind being the

Power House, Niagara Falls . . McKim, Mead & White, architects.
Power House, Metropolitan Traction Co., Houston Street and Broadway, New York . . . McKim, Mead & White architects.
Power House, Metropolitan Traction Co., Twenty-fifth Street and Lexington Avenue, New York . Wm. Schickel & Co., architects.
St. Vincent's Hospital, New York . Wm. Schickel & Co., architects.
Mail and Express Building, New York, Carrere & Hastings, architects.
S. P. C. C. Building, Twenty-Third Street and Fourth Avenue, New York . . . . . Renwick, Aspinwall & Renwick, architects.
Mohawk Building, New York . . . W. H. Robertson, architect.
Storage Warehouse, Rose and Duane Streets, New York, Wm. H. Russell, architect.
Reception Hospital, E. Sixteenth Street, New York, Chas. S. Warner, architect.
Abbey's Theater, New York . J. B. McElfatrick & Son, architects.
Drexel Institute, Philadelphia . . Wilson Bros. & Co., architects.
Reading Terminal (Twelfth Street Entrance), Philadelphia, Wilson Bros. & Co., architects.
Betz Building, Philadelphia . . . . Will H. Decker, architect.
Broad Street Station, P. R. R. Co., Philadelphia, Furness, Evans & Co., architects.

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THE
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THE BRICKBUILDER.

AN ILLUSTRATED MONTHLY DEVOTED TO THE ADVANCEMENT OF ARCHITECTURE IN MATERIALS OF CLAY.

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IN our efforts to bring to the attention of the manufacturers of brick the ideas of some of our leading architects relative to the kind of brick for which there will be demand; at the same time pointing out some of the defects which unquestionably exist in a large percentage of the product now being put upon the market, we feel that we shall be performing needed service within the limitations of our field.

It is our purpose to watch carefully the best interests of the industries which we represent, and we know of no more effectual way of establishing a thorough understanding and friendly relationship between the architect and manufacturer than by an open and fair interchange of views.

Below we publish the third letter on Colored Bricks.

IT is rather interesting, in studying the architectural productions of the last ten or fifteen years in this country, to notice that brick, which is one of the oldest manufacturing building products that we know of, should be the prime vehicle in the elaboration of an entirely new departure in building methods. A twenty-story steel-framed building can, of course, be built with facings of stone, but it is pretty generally admitted that the best material to use for encasing the steel skeleton is burnt clay in some of its various modifications. The new movement in architecture marks what might fairly be called a Brick Era, and never before has the architect been offered so wide a selection in both brick and terra-cotta. Starting with the plain red, we have worked through all the colors of the rainbow, including both black and white; and, with such a variety of possible treatments, the wonder is not that we have so many instances of misapplied terra-cottas and colored bricks, but, rather, that the failures are not a thousand times worse than they are.

We all admire the old brickwork of Italy, Spain, and the Rhine provinces, and our architectural students will go miles out of their way to see walls constructed of materials which, perhaps, our modern manufacturers — fortunately, not all of them — would scorn as crooked, badly burnt, or uneven in color, but which in place owe a considerable element of charm to the very irregularities of mold or burn to which we might object in a modern product. It is undoubtedly true that the success of the old builders was due less to deliberate intent than to the fact that in those days they had no wide range of color or quality, and could not depart very far from a safe treatment of their surfaces. A brick was a brick, neither pressed, water struck, sprayed, nor enameled, but just a plain brick. Fortunately, it was also a good brick, and, though there was not a great deal of variety as compared from brick to brick, the process of manufacture by hand gave a variety of tone which resulted in beautiful wall textures. We approximate those effects still with our common brick, but somehow we have totally failed to touch such results with our better qualities. There comes to mind at this moment a building in Boston, on a prominent street corner, which is faced with a very carefully selected brick. The building rises considerably above its neighbors, and the party wall which is exposed to view from the street is faced up with an ordinary, hard-burned brick. The result, however, is that the unstudied, common brick wall has a beautiful, tender pink tone, while the face brick, which was intended to be much more ambitious, loses itself as a wall texture. In the old days they went it blind with their brick, and by simply following good precedent accomplished results which are sometimes the despair of our modern artists. But we, in this omniverous nineteenth century, have eaten of the tree of knowledge, and we cannot build our brick walls in the simple customs of our forefathers. We must select, we must endeavor to analyze in advance, and in theory, at least, we should try to predicate results. It is sometimes difficult to make an obdurate client, or we may say even a successful manufacturer, appreciate an architect's feeling about a brick wall. Those who study the possibilities from an artistic standpoint readily appreciate that texture is sought far oftener than color, and that the surface of the brick, or even the particular pigment used in coloring matter, really counts for less than the final appearance of brickwork when laid up in joints. Judging by many of the samples which are put upon the market, it would seem as if the manufacturers work from a small sample brick up to a wall color, rather than from a wall surface down to an individual brick, and the difference is a very marked one in its results. Half a dozen shades of brick which might tone beautifully when placed side by side on a drawing table would either fade into nothingness or be hideously glaring when put together in large masses on a wall. And the only sure way to determine how the bricks are to look in a building is to build a wall of them and look at it under various conditions of the weather.

One difficulty with modern brickwork is that it is no longer wholly a constructive material, but is treated too largely in a decorative sense, much as terra-cotta itself, which is rightfully as truly a constructive material as brick, and which is still used in a constructive sense for our floors and partitions, but for external application has come to be nothing but the veriest film of veneer on the outside of a rough brick wall. If face brick were made less carefully, perhaps, but more thoroughly, and with a better appreciation of tones, our brickwork would show more logical and more interesting results and the coarser material would have even a better hold on the public appreciation than it does now as compared with stone. The immensely widened possibilities in color which the modern brick manufacturers have placed at the disposal of the architect have not been accompanied by a corresponding increase in the quality of the work. One can go through the market to-day and, aside from the output of a very few kilns, it is safe to say that nine tenths of the bricks that are manufactured and put on the market are not fit to use in a building which is calculated to last more than a couple of generations. There are plenty of instances of brickwork which has looked to be all right, but which the slow action of time has corroded in a few years to such a point that the brick was practically worthless. The brick manufacturers are not alone to blame for this result. They have simply met the demand for a fine-looking but inexpensive product. Every architect knows the difficulty of getting good first quality brick delivered at the building, and if the manufacturers would follow the notable examples set by a very few of the brick firms, and would concentrate their energies upon turning out good bricks, rather than necessarily a great variety of colors, the color of brickwork itself would by a process of natural selection resolve itself into the tones which are most pleasant and the colors which are most satisfactory for general use. There is no manufactured architectural product into which so much pure caprice has entered as in the production of the so-called fancy bricks. Some of them have done a good work. More of them are absolutely worthless, and the majority of them have been poorly made and are treacherous material for an architect to depend upon. This country is still so young, or at least has so few buildings which have stood for generations, that we are sometimes oblivious to the perishable quality of the materials used about us, and we build so truly for to-day that the possibility that our buildings may not outlast half a century troubles us very little. There are really only three materials at our disposal which are perfectly reliable for external wall construction; namely, the best selected granites, one or two grades of southern marble, and burnt clay in its various forms. While the advantages are strongly in favor of the latter, it behooves the manufacturer to keep up the standard and to let none but the best leave his yard.

But there are bricks and bricks. Perhaps we ought not to blame the manufacturer at all, but say the poor quality of bricks is more truly due to the ignorance of the architects in allowing themselves to be so easily imposed upon. But when the time comes that our manufacturers will cease studying their samples and will work back from the brick wall, we will have far less trouble in determining just what shades to use in a certain place in order to produce certain results, and brick can then take on an artistic value which now comes only from most diligent seeking and experimenting on the part of the architect. — C. H. B.

Will the parties who submitted the drawings in the City House Competition marked "Penciler" and "N. H." (combined) send us their address, as the envelopes containing same have been mislaid?

The design by Mr. Hendrickson, winner of the second prize in the City House Competition, will be published in the September number, and that of Mr. Wight, which took the third prize, in the October number.

On Plate 51 (this number) may be found the measured drawing by Mr. C. H. Alden, Jr., of the arcade on north and south sides of cloister, San Zenone, Verona. A description with illustrations of the cloister of San Zenone is given with Street's "Brick and Marble in the Middle Ages" in The Brickbuilder for September, 1894.

REPORT OF THE JURY ON THE BRICKBUILDER COMPETITION FOR A CITY HOUSE.

To the Proprietors of the Brickbuilder:

Gentlemen, — The high average of excellence among the designs submitted to us made the task of your jury an interesting and not altogether an easy one. Comparatively few of the designs were really poor. After a careful study of all, two were found to stand easily first — not only in design, but in draftsmanship — viz., those marked with a "Door-knocker" and "Wren." These two were better planned, simpler, and more refined in design, better proportioned, and better rendered than any others. It was a less easy matter to determine between them. To "Door-knocker," however, clearly belongs the first place. The superiority over "Wren's" design is most apparent in the plan. The latter's entrance and entrance-hall are unpleasantly narrow. "Door-knocker," by a judicious disposition of his hall and staircase, and by placing his parlor in the upper floor, gains with an actually smaller ground plan a sense of amplitude and livable comfort that is lacking somewhat in the more symmetrical plan of his competitor. The width of entrance is a great advantage also to "Door-knocker's" elevation. The one fault of "Wren's" otherwise unusually graceful and well-proportioned design is the narrowness, the somewhat pinched look of the porch; and it may be added that the Doric order is the one of all others least adapted to treatment in terra-cotta, the triglyphs flatly contradicting the necessarily arched construction of architrave and frieze. "Wren's" elevation rather suggests that the principal rooms are in the second story, which the plans show not to be the case. "Door-knocker's" interior arrangement is well expressed in the façade; but both designs deserve high commendation, and are very much superior to the average house that gets built.

The jury found somewhat more difficulty in selecting the third prize, but the charming quaintness and piquancy of the design of "Bluenose," obtained by the simplest means, seemed, after careful consideration, to place it above the remaining competitors. Its simplicity and its carefully studied fenestration are especially to be commended. But the two bull's-eye openings just below the cornice are unfortunate and seriously mar the design. They might have been omitted entirely. The plan is good, but the shape of the window alcoves in the reception hall is objectionable.

In addition, the jury specially commends the designs of "Red Maltese Cross," "Greek Cross," "Bee," and "F. G. in circle."

"Red Cross'" plan is too much cut up; the bath-room is placed on an interior wall instead of on an outside wall, a fault that occurs also in other designs. The shape of the gable window and its treatment is ugly, and there is a want of complete harmony between the entrance arch and the adjoining window, giving an unpleasant restlessness to this portion of the front; but the design is picturesque and interesting.

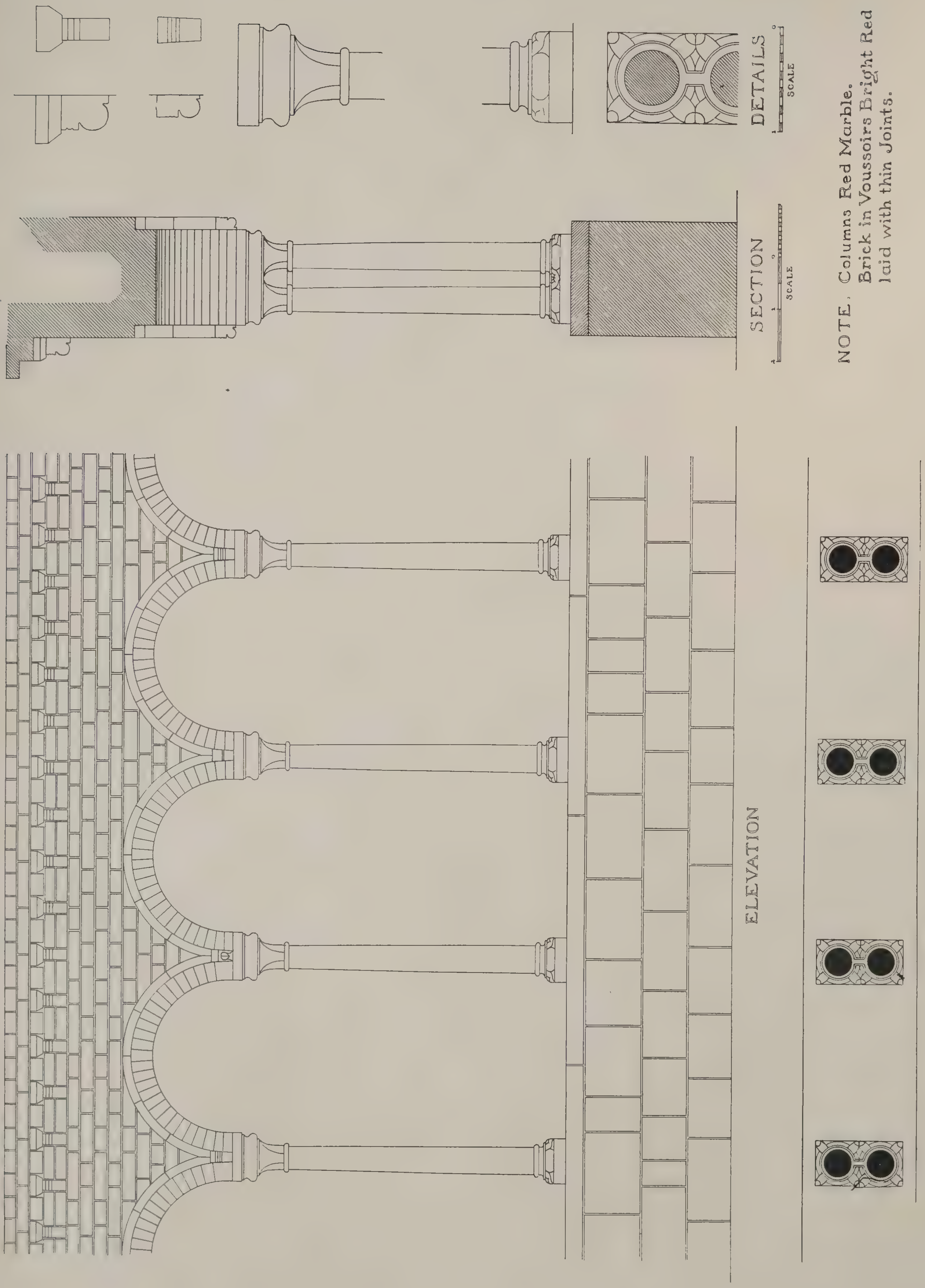
"Greek Cross" wastes a great deal of room in halls and passageways. In spite of its undue enlargement, the hall is too small to make a two-story treatment pleasant, and its irregular shape is ugly. The façade is a straightforward and pleasantly proportioned treatment of the motive of a pilaster order, enclosing two stories with basement below and attic above.

"Bee" and "F. G." present designs of similar motive, the former somewhat better carried out and with a better plan. The Bramantesque windows of the second story in "Bee's" design are too wide to be pleasant in proportion and are somewhat out of scale, as is also the hood over the entrance. The cornice projection is much too great, especially for terra-cotta.

Greater care in the study of proportion is needed in both these designs; but the motive is good and is fairly well carried out.

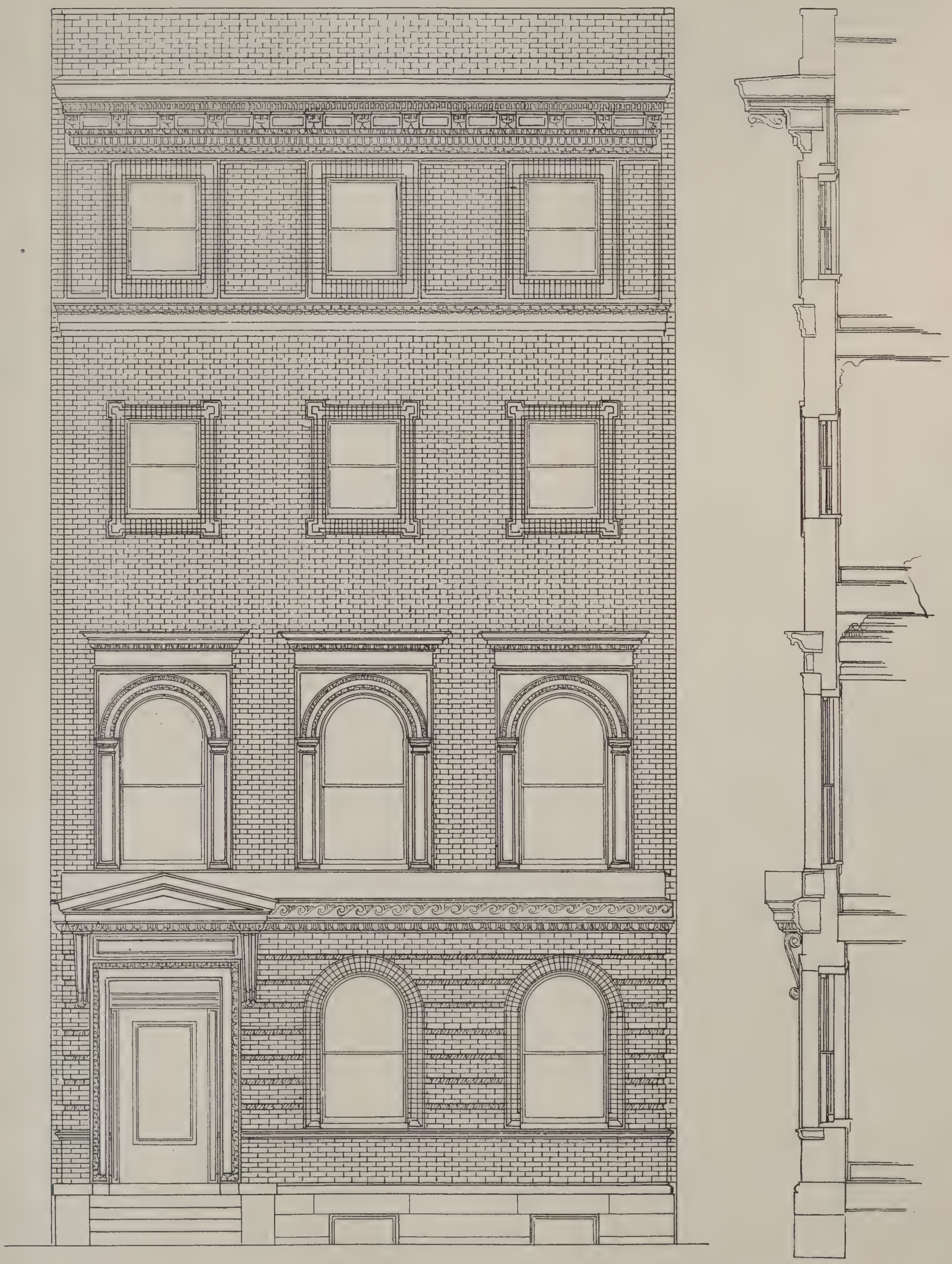
Respectfully submitted,

H. Langford Warren.
C. Howard Walker.
C. H. Blackall.



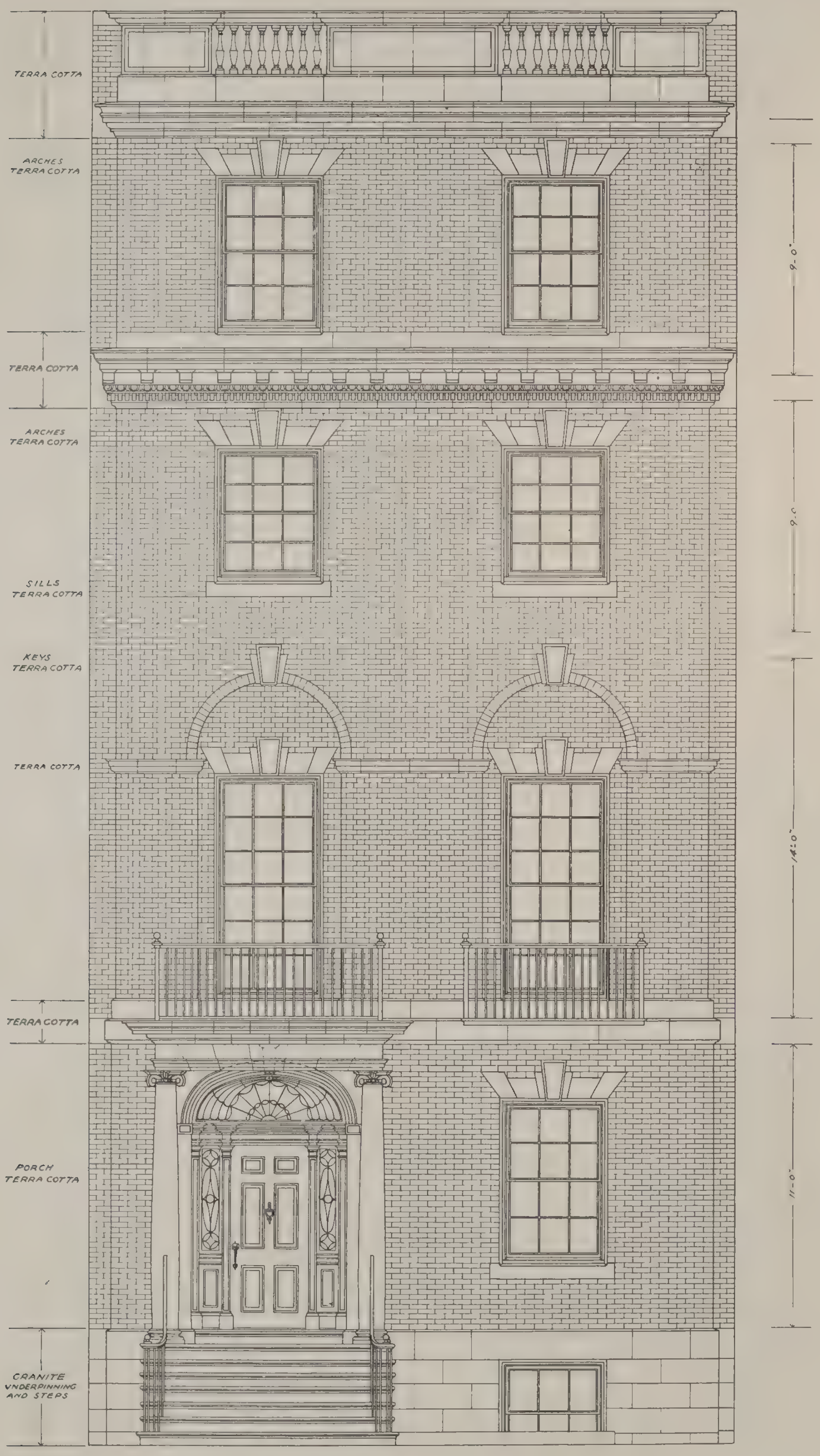
NOTE. Columns Red Marble.
Brick in Voussoirs Bright Red
laid with thin Joints.

MEASURED DRAWING OF THE ARCADE ON NORTH AND SOUTH SIDES OF CLOISTER, SAN ZENONE, VERONA.



BRICKBUILDER COMPETITION FOR A CITY HOUSE.

SPECIAL MENTION. WILL S. ALDRICH, BOSTON.



ELEVATION

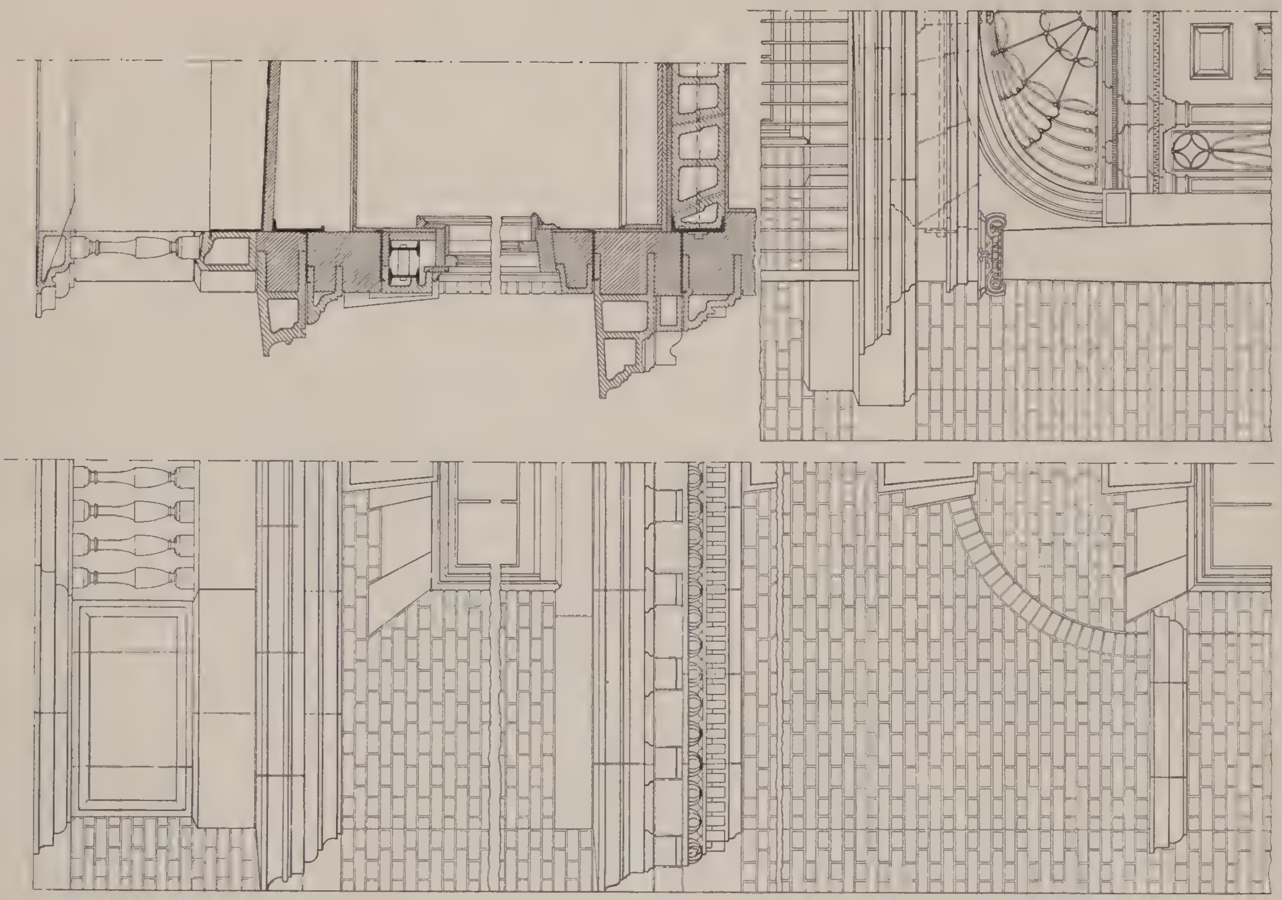
SCALE 0 5 10'

BRICKBUILDER COMPETITION FOR A CITY HOUSE.

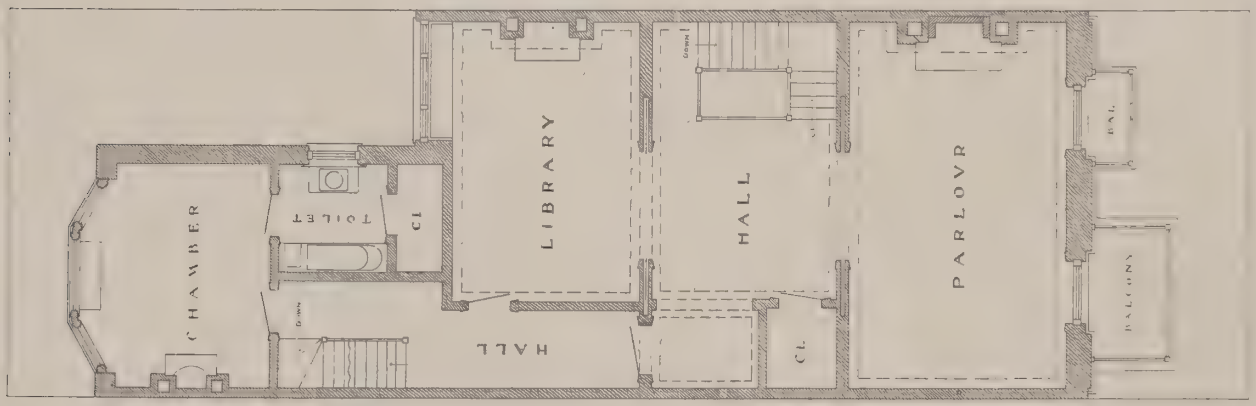
First Prize, EDWIN R. CLARK, Lowell, Mass.

BRICKBUILDER COMPETITION FOR A CITY HOUSE.

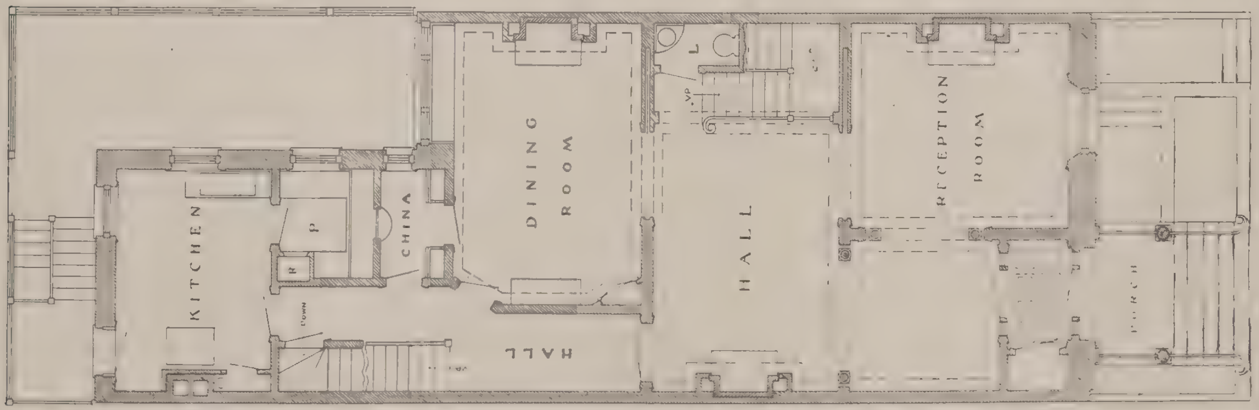
FIRST PRIZE. EDWIN R. CLARK. LOWELL, MASS.



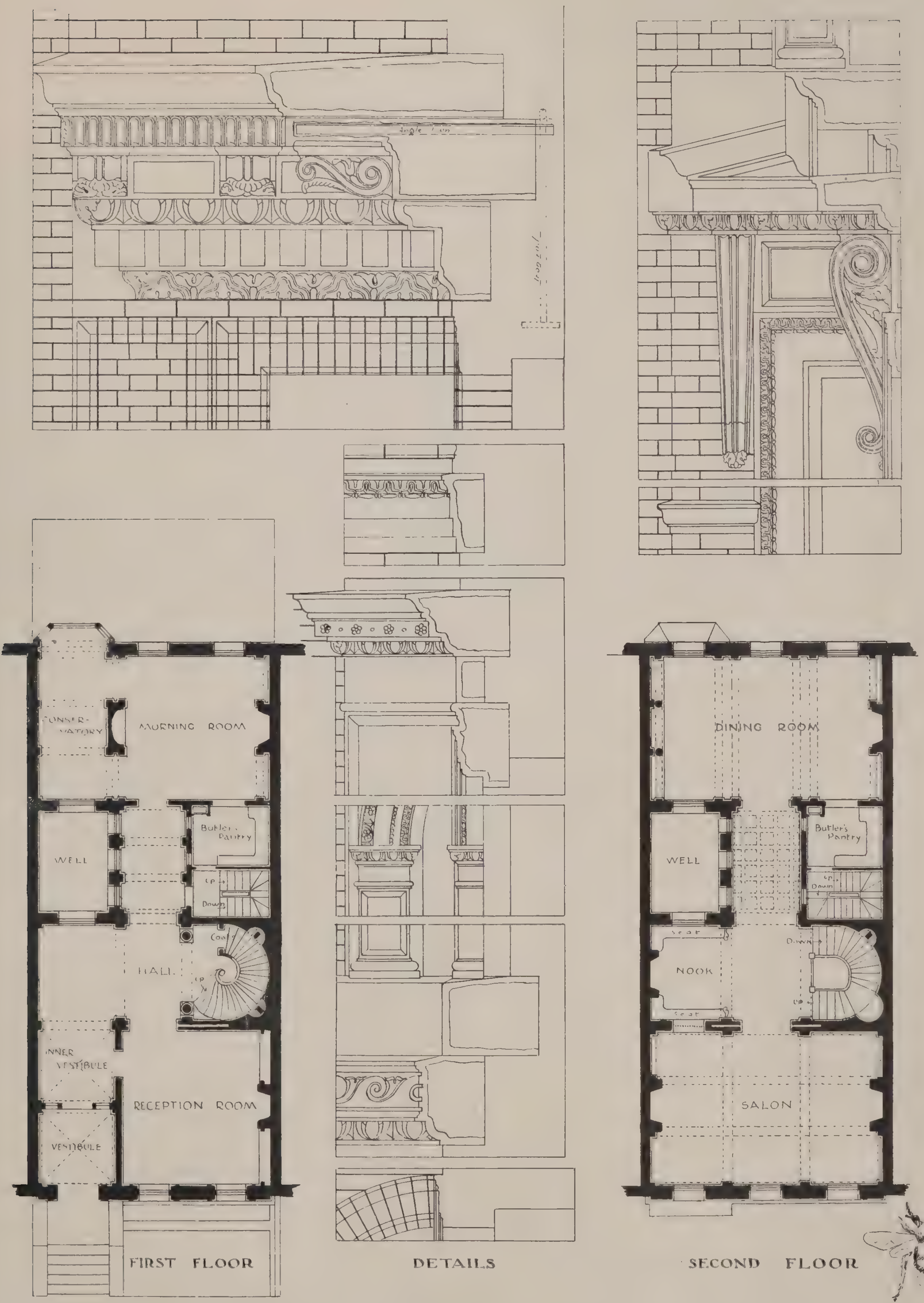
DETAILS



SECOND FLOOR

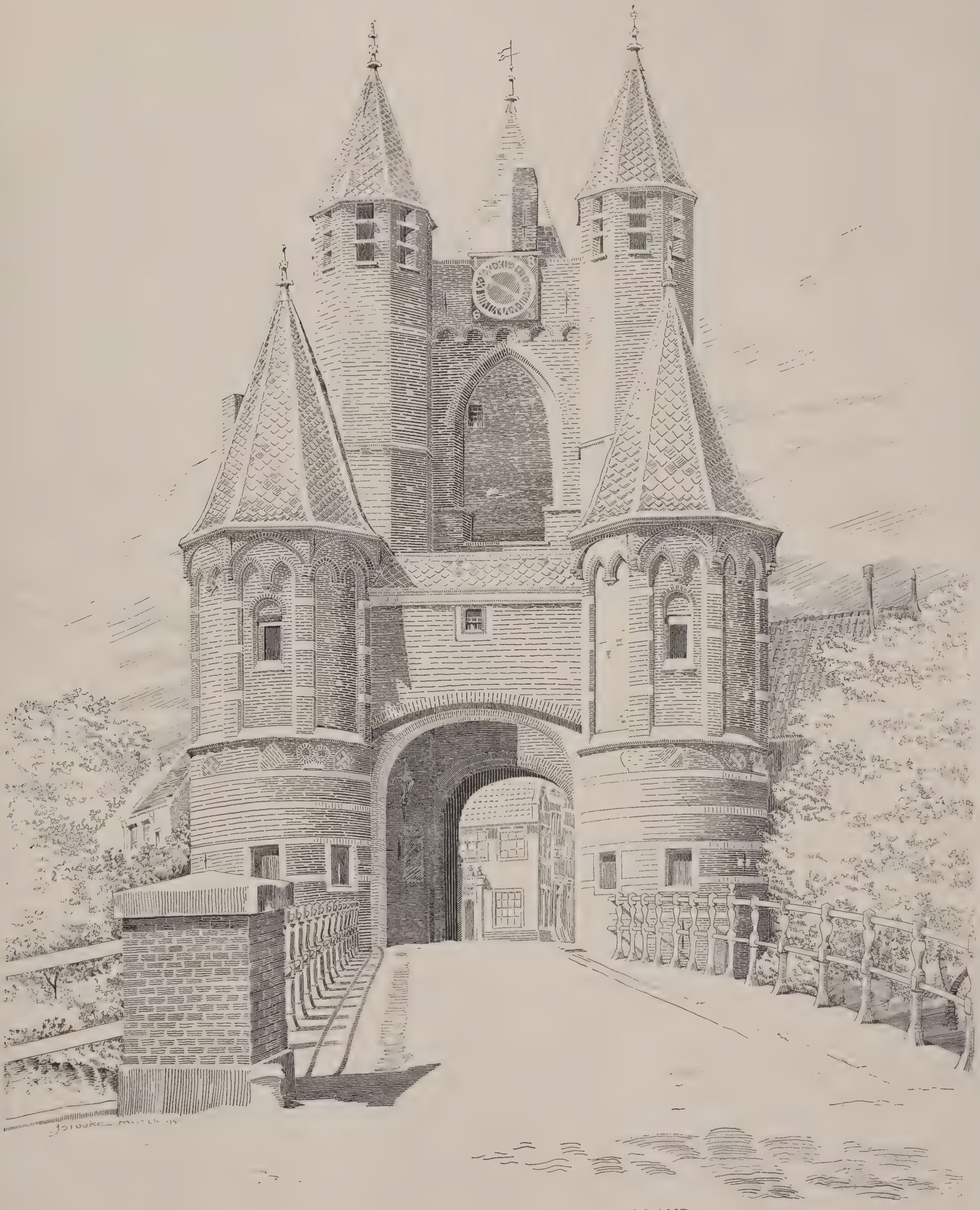


FIRST FLOOR



BRICKBUILDER COMPETITION FOR A CITY HOUSE.

SPECIAL MENTION. WILL S. ALDRICH, BOSTON.



THE AMSTERDAM GATE, HARLEM, HOLLAND.

C. J. BROOKE, DEL., PHILADELPHIA.

OUR ILLUSTRATED ADVERTISEMENTS.

ON page xix The Hydraulic-Press Brick Company illustrate in their advertisement the Eglise des Jacobins, Toulouse, which is a good type of brick architecture of the Middle Ages existing in the south of France. It was built towards the end of the thirteenth century, and the photograph shows how well it has withstood the test of the intervening six hundred years.

On the opposite advertising page of The New York Architectural Terra-Cotta Company will be found another fine Gothic church of brick and terra-cotta, but built in the waning years of the nineteenth century, in New York City, and of which Messrs. Barney & Chapman are the architects. It fronts on 14th Street and extends through the block to 13th Street, and comprises lecture, reading, and meeting rooms, necessary for effective parochial work in a thickly populated, working-class neighborhood.

The angel figure which we give here was modeled by Mr. H. Piccerilli, and is one of the finials placed on the shaft to each side of the four dormers on the tower.

The fine figure of St. Paul leaning on the sword of the Spirit fitly represents the church militant. It is the work of Mr. S. Stern, and will be placed in the niche prepared for it between the two richly molded and crocketed archways on 14th Street. Both of these artists are employed on the staff of the above company.

COMPETITION.

WE are authorized by the New York Architectural Terra-Cotta Company to announce a competition for the best design for a full-page advertisement to be used in THE BRICKBUILDER. The drawings must be made in line with black ink on sheets cut to the uniform size of 14 by 18 inches. For the best designs there is offered a first prize of $50, a second prize of $25, a third prize of $15, and a fourth prize of $10. The prizes will be awarded by a jury of three architects of acknowledged reputation. Each drawing must be marked with a motto or cipher, and a sealed envelope similarly marked containing the full name and address of the designer must accompany the drawing. These envelopes will not be opened until after the award is made. The designs for which prizes are awarded will become the property of the New York Architectural Terra-Cotta Company. THE BRICKBUILDER reserves the right to publish the successful designs. Other drawings, at the conclusion of the competition, will be returned to the competitors. Drawings must be delivered flat, express or postage prepaid, at the office of THE BRICKBUILDER not later than October 1.

TO DRAFTSMEN.

ANY draftsman out of employment, who will send us his full address and answer the following questions: —

By whom were you last employed?
Can you furnish good recommendations from your last employer?
On what particular line of work have you been engaged?
What salary do you expect to receive?
Are you willing to go to another city?

may have his name placed in our Exchange Bureau, and will be notified of any parties desiring his services as a draftsman.

All such communications will be regarded as confidential, and no charge will be made.

Address, EXCHANGE BUREAU,
THE BRICKBUILDER PUBLISHING CO.

TO ARCHITECTS.

WE call your attention to the foregoing announcement, and upon your application would be pleased to put you in communication with any draftsman whom we think would meet your requirements. All communications will be regarded as confidential, and no charge will be made.

Address, EXCHANGE BUREAU,
THE BRICKBUILDER PUBLISHING CO.

COMPETITION.

MR. WM. CONNORS, Troy, N. Y., the well-known manufacturer of "American Seal" Mortar, Stains, and Roofing Cement, authorizes us to announce a competition for the best design for an advertisement to be used in THE BRICKBUILDER. The wording which is to be incorporated in the design may be found in Mr. Connor's advertisement for this month on page xxiv.

The drawings must be made in line with black ink on sheets cut to the uniform size of 4 by 11 ins. Each drawing must be marked with a motto or cipher, and a sealed envelope similarly marked, containing the full name and address of the designer, must accompany the drawings. These envelopes will not be opened until after the award is made. The designs for which prizes are awarded will become the property of Mr. Connors.

For the best design, there is offered a first prize of $25, a second prize of $15, and a third prize of $10.

The prizes will be awarded by a jury of three gentlemen competent to judge of this class of work.

Drawings must be delivered flat, express or postage prepaid, at the office of THE BRICKBUILDER, not later than October 1.

THERE is a little paper published in Chicago called the *Clay Record*, the editor of which dropped his scissors long enough to pen an editorial in a recent issue, the purpose of which, we presume, was to annihilate THE BRICKBUILDER. We are not counted on earth by the writer of the article, because we are printing a translation of Choisy's "The Art of Building among the Romans" and reprinting Street's "Brick and Marble in the Middle Ages." We would inform the gentleman who wears "a 15½ E. & W. collar," and probably a 5½ hat, that Choisy's "The Art of Building among the Romans" is the subject of a special course at the Massachusetts Institute of Technology, and we think that a translation of this standard work, with the reproduction of Street's "Brick and Marble in the Middle Ages," which is now out of print, is of as much value to the readers of a technical journal as funny advertising poetry and a lot of cheap trade "taffy."

We are inclined to think that the real cause of this terrible heat "under the collar" is that some time ago we took this editor to task for "cribbing" from our columns without giving credit; also, that we asked him at the time if an editorial which appeared in his columns, claiming the leadership among the trade journals devoted to the interests of manufactured clay, had not been "cribbed" from one of the other papers.

If the editor in question has any more scathing (?) editorials for us which he would have widely read by the clay workers of the country, we would suggest that he hire space in Brother Randall's paper.

BRICK AND MARBLE IN THE MIDDLE AGES.

G. Edmund Street.

CHAPTER VIII. — *Continued.*

THE assumption that the Piazzetta-front has been copied from the sea-front involves a belief in a veneration for an exact imitation of older work which is (to say the least) extraordinarily rare, if not unique, in mediæval works. It involves a belief also in the possibility of a spirited and successful copy being made of an old capital by a mediæval sculptor without fresh thought or any fresh invention of any kind. This will be seen if we examine the capitals of the lower stage of the palace. Here, at first sight, one is struck by what appears to be the astonishing variety of the capitals. They are nearly all adorned with figures or subjects, as well as with foliage, and are certainly in both fronts of various degrees of merit; but on closer acquaintance it is perceived that the variety of capitals is not so great as it seems, for that several of those in each front are merely replicas of those in the other. If any portion of the two lower stages had been built before the rest, it would have been the whole of the sea-front and six arches of the Piazzetta-front, for at the end of these there is a column equal in size to those at the angles, and which might therefore by possibility itself have been an angle column for a time. But its larger size may also fairly be accounted for by the fact that it comes under the side wall of the large building above, and was in any case, therefore, a convenient arrangement, if not quite a necessity; but the real difficulty seems to me to be that if there were any considerable difference in the date of these works all experience would lead one to expect that the earlier works would be the most uniform and the best, whereas in point of fact this is far from being the case. For instance, in the sea-front there are various capitals which are of poor execution. These are, counting from the southeast angle, the third (large and coarse heads), the eighth (also coarse heads), the thirteenth (lions' heads), the fourteenth (beasts), and the fifteenth, which is certainly not so fine as the replica in the Piazzetta-front (the twenty-sixth capital, counting as before).[1]

The case for the contemporaneous erection of these two fronts becomes even stronger if we ascend to the open gallery on the first floor and examine the capitals there. They are all similar in general character; and, though they become gradually better as one goes from the southeast to the northwest, they give the impression of all being of nearly one date, and moreover they all appear to be later in date than the whole of those in the lower stage.

On the other hand, there seem to be at least two points which make strongly in favor of the later date which has been given to the twelve northern arches of the Piazzetta-front. These are, first, that all the eight capitals which are replicas are in this northern part of the front, and none of them in the first six arches from the southwest angle; and, secondly, that the plate armor in the sculpture above the capital of the northeast angle (Judgment of Solomon) is later in date than the period which I assume for this work, and later than the chain mail shown in the third and eighth capitals of the sea-front. To the first objection a sufficient answer is that some of the best of the capitals to these twelve arches are of original design, not replicas; and in reply to the last objection (which is of much force) the only but at the same time obvious reply is that the Trajan capital, just under this late armor, is one of the most beautiful of the entire series, and that, on the whole, it is much more likely that some of the sculpture was left in block and finished later; than that no difference should be made in any of the moldings or details of the work of two periods. There is, indeed, some, though not very strong, evidence that the sculpture of this capital is not earlier than about 1423. There is, according to Zanotto, an inscription on it, "+*Duo Soci Florentini incise,*" and he argues from the use of this last word that the two men were the same who made the monument to the Doge Tommaso Mocenigo in 1423, in which, according to Sansovino, they used the same unusual term "*inciserunt*"; this interpretation of the inscription is the more allowable in that, as I have said, the details of armor in themselves suggest a date not much earlier than this for the sculpture connected with it on the angle just above the cap. This date, of course, brings this work to very nearly the same period as that of the execution of the Porta della Carta, and it has been assumed by some that these capitals were the work of the Bons who built it. Such an assertion is as wild as that of M. Didron, who says something as to their belonging to the thirteenth century, for the very shortest inspection of the Porta della Carta would convince the most skeptical that no part of the capitals could have been executed by any of the men who wrought at it. In comparing the merits of the carvers of the earliest and the latest capitals, it is due to the latter to say that one of the finest of the whole series is this Trajan capital at the northwest angle, and there is no internal evidence in it which could lead one to suppose it to be the work of a man who would ever condescend to copy another's work.

No one can examine the building without seeing that there is, not only in the detail, but equally in the general design, a marked difference between the two lower stages and the upper stage. In place of the extreme boldness which marks every part of the former, we see moldings reduced in the latter to the smallest and meanest section possible; the windows of the upper stage are badly designed, whilst the traceries of the second stage are as fine as they can possibly be; the angle-shafts of the upper stage are of the latest type, elaborately twisted and violently defined, instead of being merely delicate roundings off of the hard line of wall, as all the early Venetian angle-shafts are; the parapet, too, is not equal in its design to any of the lower work, and crowns with an insignificant grotesqueness the noble symmetry of the two lower arcades; and finally, the chequer-work of marble which forms the whole of the upper wall is a mode of construction which I have not seen in any early work, though it is seen in the Porta della Carta (A. D. 1429), and in one other late work, the Palazzo in the Campo Sta. Maria Mater Domini.[1]

Looking at all the circumstances of the case, I think the fairest explanation of them is that the whole sea-front and the six arches of the Piazzetta (columns 1 to 24 on the plan) were first built, that the extension to the north (columns 25 to 36 on plan) was then immediately undertaken by the same artists, and finally that the whole upper story was built and the sculpture of its capitals completed before 1423. The capitals of the lower arcade were probably sculptured by degrees, and certainly not by one hand, between the years 1310 and 1361.

There is a confirmation to some extent of this view in a MS. in the Bodleian Library of the fourteenth century (the Romance of Alexander), which contains a curious contemporary view of Venice. This drawing has been engraved at page 26 of the second volume of the "Domestic Architecture of the Middle Ages."[2] Here, it will be seen, with the usual amount of license which characterizes most mediæval representations of places or towns, that it has nevertheless been intended as an absolute representation of what its draughtsmen had seen. The columns with St. Theodore and the lion of St. Mark on their capitals, the bronze horses and the domes of St. Mark's, the position by the waterside, and the representation of the Ponte di Paglia are all proofs of this; but the important point for my present purpose is that he drew the Ducal Palace as *a building*

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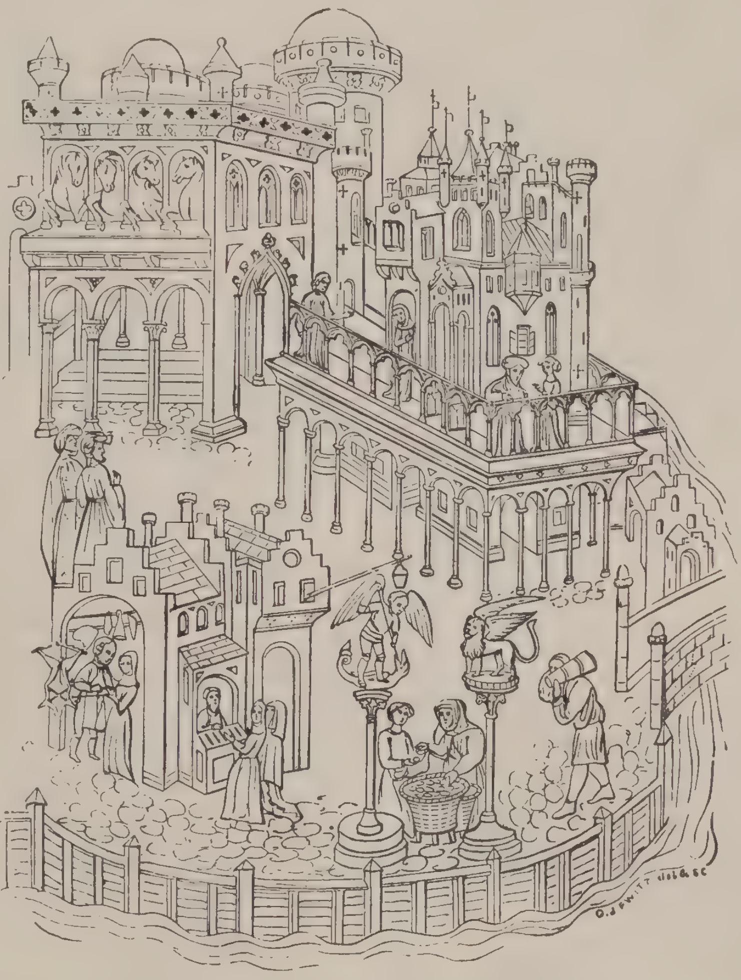
[1] The capitals which are replicas of each other are the 4th and 35th, the 7th and 28th, the 8th and 31st, the 9th and 29th, the 10th and 30th, the 11th and 34th, the 12th and 33d, the 15th and 26th. The 25th, 27th, 32d, and 36th (northeast angle) are original, though they are in the northern portion of the Piazzetta-front. See Appendix, with key-plan.

[1] The similar marble facing at Vicenza was executed between 1400 and 1444.

[2] Published by Mr. Parker, of Oxford, to whose courtesy I owe the use of this illustration.

of two stories in height — the first a simple arcade, the second an arcade with tracery. In the distance behind this his drawing shows a picturesque assemblage of buildings, whilst figures are represented behind the upper arcade, as though it were only a kind of immense balcony. There can be no doubt whatever that this old drawing tells in favor of the view that the upper stage was not built until after a considerable interval; for it is almost impossible — looking at the way in which the rest of the drawing is made — to believe that all reference to it would have been omitted, had it been in existence at the time the artist saw it.

It will be seen that my supposition that the original design of the Ducal Palace was of considerably less elevation than the present building would tend to make it very much more like the Byzantine type than it is; but even now no one can dispute the family likeness. The amount of constructive art is as nearly as possible the same. The weight is supported by a succession of shafts placed at very short intervals from each other, and in neither is there any approach to the system of pier, arch, and buttress so distinctive of Gothic art in the North of Europe. The pointed arch is used, it is true, in the palace; but, after all, the mere use of the pointed arch does not make thorough pointed architecture, and, therefore, interesting as it is as a variety of the style, the Ducal Palace is, I think, not properly to be placed in the first class of Gothic buildings. Indeed, the second stage, whose exquisite beauty is the charm of the whole building, does not exhibit the pointed arch at all in a properly developed form, and is strong enough to support the great weight of wall above only by reason of the massy character of its tracery, and not by the proper application of constructional arches. I have already said that there is no approach to buttressing; but the angles require some help, and this is given partly by increasing considerably the size of the shafts and partly by iron ties at the springing of the arches running for some distance in each direction from the angles.


G. Andrew del. & sc.

VENICE IN THE FOURTEENTH CENTURY.
From the Romance of Alexander.

All the moldings are very simple; they are generally composed of three-quarter beads, small fillets, and large flat hollows, constantly arranged in the same order. The label of the main arcade is a plain bead. In the string-courses boldly carved flowers are repeated with a slight interval between each, and the upper string-course has a row of nail-heads in one of its members. The cusping of the tracery is quite square in its section, and the cusps finish with a square end, to which is attached — and with good effect — a small circular ball of red marble. The parapet is of the somewhat peculiar kind I have already mentioned, and I confess I have never been long enough in Venice to accustom myself to or to admire its extreme peculiarity of both outline and design.

And now, before we leave this subject, let me offer a remark, as every one who writes on it must, on the admirable story of these sculptures. I have never sat in front of one of them for any space of time without seeing some wayfarer stop to study the story of some one of the capitals. They are a book at which more thousands have looked with pleasure for some five hundred years than at any other single book in the world, with the one exception of the Bible. And the lesson to architects is obvious. Concentrate your labor and your story on some one part of your building where all men may read it; tell some simple story, and you will interest your readers, if you will but tell it so simply that by good chance they may be able to read it. Lay out a scheme so well that if you die your successor may carry it on. Here, as I believe, the architect completed his two stages of arcades, whilst the sculptor was changed, but kept generally to the scheme of subjects first of all laid down. At the three exposed angles are the three archangels; below them the moral lesson — as much wanted now as then — of the Drunkenness of Noah, and the Story of Tobit (with St. Raphael); at another angle, The Fall (under St. Michael); and at the last the Judgment of Solomon (under St. Gabriel). In the lower range of capitals the stories and catalogues of virtues and vices; the illustrations of fruits, animals, every-day life; the labors of the months, trades, sciences, and arts are all illustrated, and complete a cycle of subjects which, ill treated, would always have a certain value, and which, well treated, as most of them are here, have the very highest charm.

(*To be continued.*)

FACING BRICKS.

BUILDING in brick has been resorted to in this country for a long time, says a writer in an English journal. Not so on the Continent, where brick has come into more extended use only in recent years. The taste for brickwork is spreading everywhere, not only in districts poor in quarry stone, but all over France, Germany, and Switzerland, where, even for buildings of some architectural importance, rough masonry work was the prevailing mode. In Switzerland, especially, where the workmen have had little experience, building with brick is looked upon as expensive and luxurious. In consequence of the prevailing tendency of combining the beautiful with the useful, facing bricks of various sizes are now manufactured in Germany and Switzerland, by the employment of which builders are enabled to erect walls for nearly their whole thickness of bricks or cement slabs, even partially of quarry stones, which may be obtained everywhere at very low rates, especially now, and to face them afterward with a finer description of bricks. Bonding is preserved in the usual manner by joining the inner bricks in such a manner as to use for facing alternately quarter, half, or three quarter bricks. This way has the advantage, besides cheapness, of permitting the facing bricks to be put in afterward, so that they cannot be soiled or damaged.

The bricks are made hollow, by which means a considerable saving is made in the cost of carriage, and, in order to secure a better hold for the mortar, provided at the sides with ribs and grooves.

THE ART OF BUILDING
AMONG THE ROMANS.

Translated from the French of Auguste Choisy
by Arthur J. Dillon.

PART II.
CUT STONE MASONRY AND ROMAN FRAMING.
FIRST CHAPTER.
GENERAL METHODS OF CUT STONE CONSTRUCTION.

(*Continued.*)

ONE thus perceives the influence exercised on ancient art by this method of preparing the materials, whose most remarkable examples date from the sixth and fifth centuries before our era. The aspect of edifices whose construction was often interrupted, accustomed the eye to the roughed-out forms of the preliminary cutting. Later, their age itself consecrated them, and, introduced into the architecture to satisfy practical exigencies, they were kept there by the strength of tradition, and persisted long after the abandonment of the methods from which they arose. Certain combinations passed, little by little, from the domain of the art of building to that of decoration; and the spirit of the architecture was insensibly modified, although the outward form remained almost invariable.

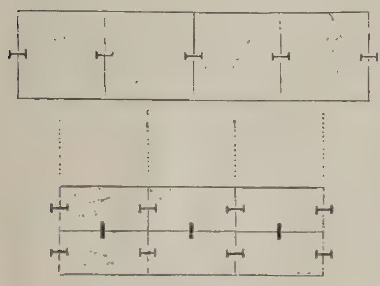


FIG. 64.

These changes, however, had but a mediocre influence on the general character of cut stone masonry, and the arrangement of the stones continued to be, in the last days of Grecian art, that which it had been in the sixth and fifth centuries. This (Fig. 64) is what it usually was in the primitive architecture of the Greeks; and such it was in Rome during the entire period of the Empire. There is never to be seen some stones in a course traversing the wall, while others extend but partially through it; either all the stones of a course extend through or else none of them do so; a course of bond stones or headers (Fig. 64, first sketch) alternates regularly with two courses of stretchers (Fig. 64, second sketch).

This type is the conventional one for all walls built entirely of cut stone; and, under this head, it applies to all cases of Grecian construction. But when it was necessary to combine revetments of cut stone with backings of rubble the consecrated forms had to be modified, and then the builders invariably used one or the other of the two forms shown in Figs. 65 and 66. Either they alternated courses of headers with courses of stretchers, as in Fig. 65, or else (and this was the most frequent solution) they alternated courses of stretchers with courses composed of both headers and stretchers (Fig. 66). In a word, it was either the alternation of courses of headers and courses of stretchers, or it was the alternation of courses of stretchers and courses of both headers and stretchers. These were the two ways; and in no Roman edifice have I found two mixed courses directly superposed; everywhere a course of stretchers is placed between the bond courses, so that the stones that project into the rubble reoccur only in every second course, a combination which, essentially economical, has, moreover, such advantages of solidity that its use can be recommended at the present time.

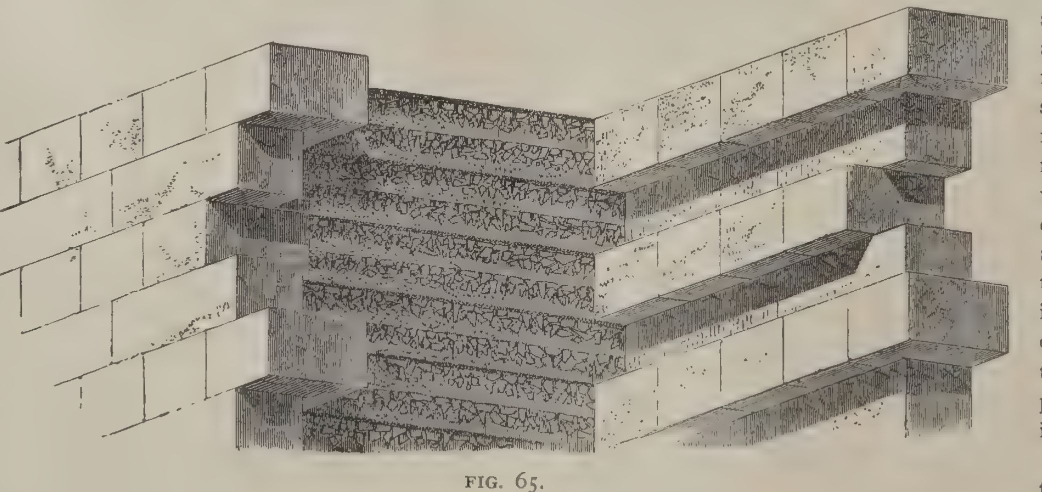


FIG. 65.

It is not, in fact, the question in obtaining a good bond of simply multiplying the stones that penetrate into the backing; these headers, if too near together, cut up and divide the rubble which they penetrate, so that it tends to give way at the first effort to pull them out. The arrangement shown in the last figure would seem to diminish this danger to such a point as to render it fictitious. In this combination, the headers are so many strong, isolated ties which pierce the rubble from point to point, near enough together to bind the revetment firmly to the backing, but far enough apart, in every direction, to assure the strength of the rubble which separates them.

The applications of this system are unending. It is the arrangement of the sub-basement that carried the tomb of Cecilia Metella; it is that of the other circular mausoleum, between Rome and Albano, which is known as the Casale Rotondo. In these monuments the stretchers of the revetment have almost all been torn off by main strength, and the headers, broken off flush with the rubble, appear as isolated white rectangles on the gray background of the walls. Lastly I will cite the buttressed wall of Roman construction which upholds the platform of the temple of Jupiter Olympus in Athens (Fig. 67). Here, again, the headers occur only in every second course; and this is the characteristic of the revetments of the ancient rubble masonry.

A well-known and characteristic detail of ancient masonry of cut stone is the absence of mortar in the joints. Even when the stones were built in connection with rubble concrete they were laid dry; and this practise, far from being limited to works whose object was decoration, was extended to those where the thinness of the joints would seem a matter of indifference, as, for instance, to partition walls that were to be plastered, and even to walls used as foundations.

In order to comprehend this exclusion of mortar, we must go back to the theory that the Romans had of its rôle; with them it was a binding material, nothing more, and they never thought of using it to transmit pressure or to level up the beds. In using it in their concrete construction, they gave it a single function, which was to bind the small stones together, as a sort of plastic matrix. In a construction of large, regularly shaped material the mortar was not strong enough to produce a similar effect, so they then looked on it as useless, and employed, to bind the blocks together, pieces of iron leaded in.

I will not stop to describe the different kinds of ties they used to clamp the stones together; here, again, they found in the Grecian edifices models that they were content to follow. The Greeks always made the ties of iron, never of bronze, and the only material used to solder them in was lead. The Romans imitated

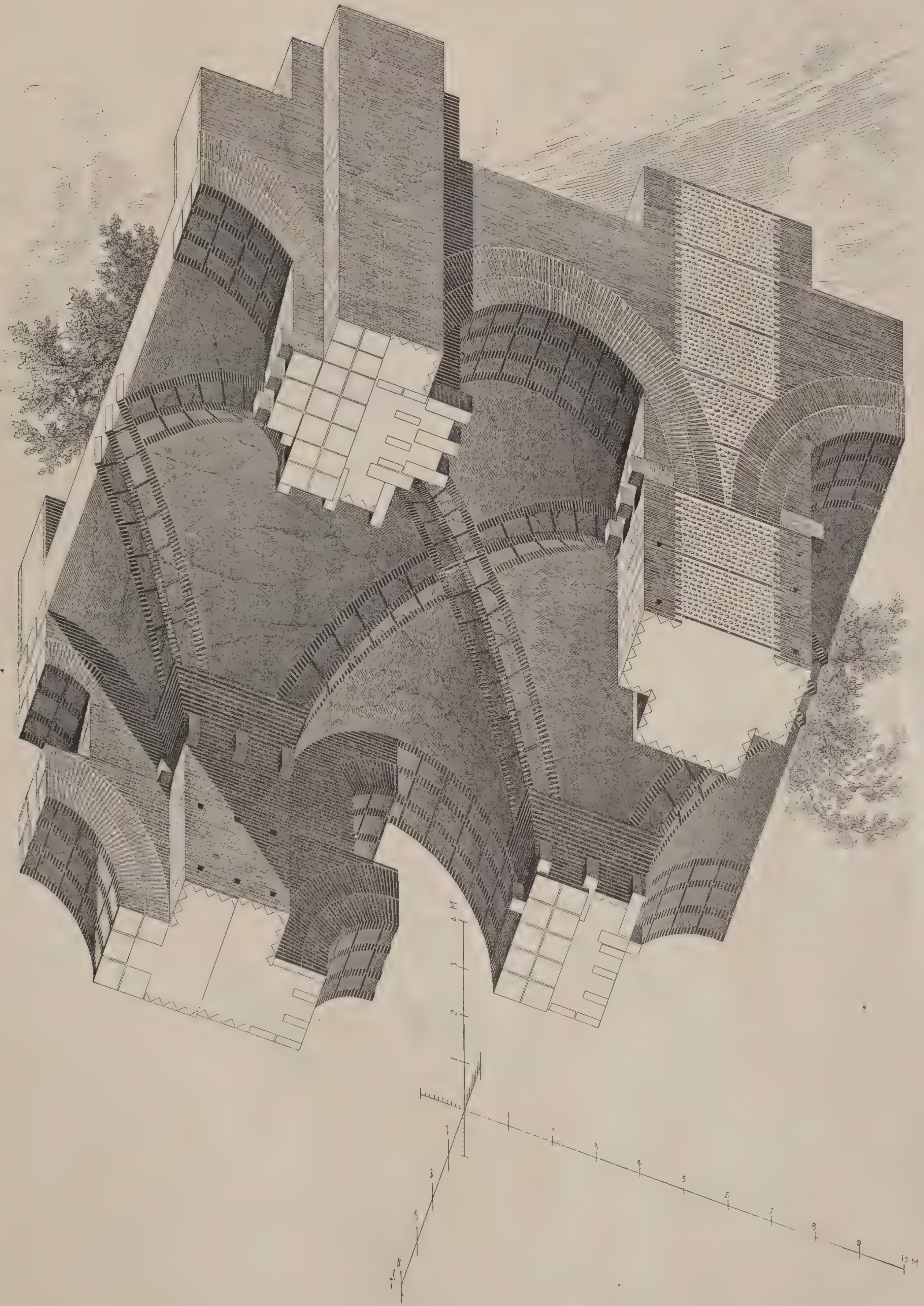


PLATE VIII. THE ART OF BUILDING AMONG THE ROMANS.

them, and the three types given in Figs. 68, 69, and 70 are found again in their buildings. Sometimes they substituted dowels of metal, of wood, or even of marble, whose shape and use are shown in Fig. 71, taken from a bridge in the south of Gaules, the bridge of Gallargues. But more often the Romans used a dowel (Fig. 72) thicker at the ends than at the middle, which was leaded into the upper stone. When this was set the dowel was engaged in a mortise in the lower stone, in which it was fixed by running lead into the mortise through a suitable channel, previously cut. This system, which seems the most recent, was the most general; but its use, far from assuring the security of the buildings where it was employed, was indirectly a cause of their destruction. The metal buried in the walls excited the cupidity of the barbarians who succeeded the Romans in Italy, and the channels filled with lead were so many clews to its hiding-places; so that the greater part of the ancient monuments show in the places formerly occupied by the metal clamps roughly drilled holes, made in extracting the iron and lead.

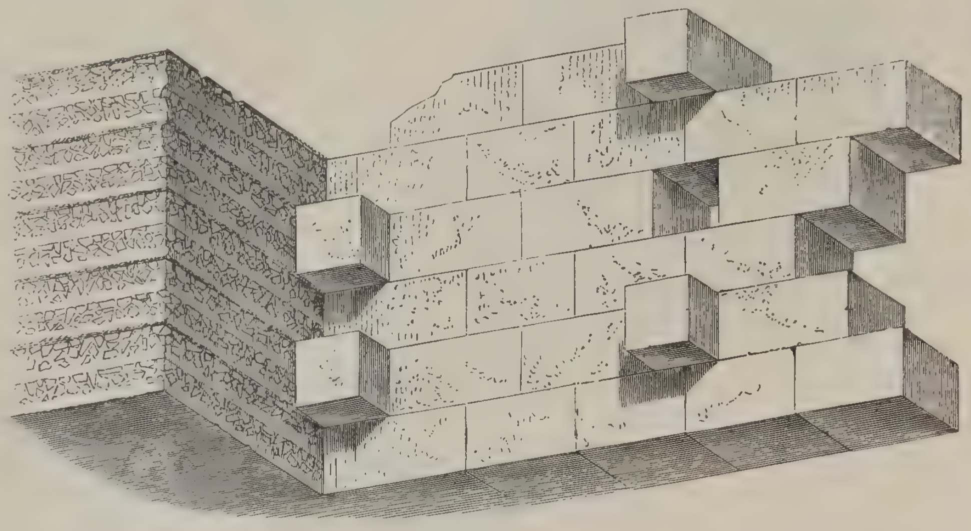


FIG. 66.

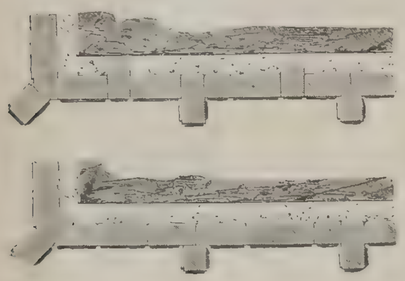


FIG. 67.

We now come to the question of handling the stones and of the means the ancients had at their disposal. A well-supported opinion has it that they were content with incline planes over which to drag their material to its final position. I do not know what basis there is for this view; it is perhaps the true one when limited to the edifices of gigantic stones which mark the infancy of civilization; but to extend to the Greeks, and particularly to the Romans, the idea of constructing temporary roadways for the sole purpose of carrying their materials to the top of their edifices is, I believe, to credit them gratuitously with a method whose costly simplicity is not in harmony with what we know of their tendency to free themselves from auxiliary works. Only a few vague texts can be brought to support this view,[1] while, on the contrary, the direct testimony of the ruins, agreeing with what seems to be the truth, is evidence of methods that are at the same time less primitive and less costly.

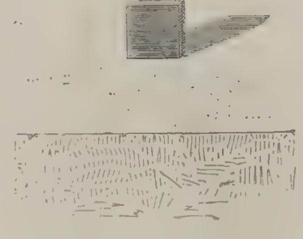


FIG. 68.

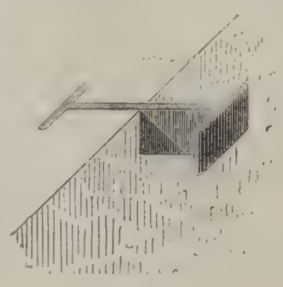


FIG. 69.

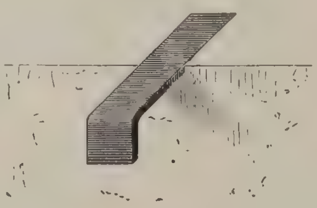


FIG. 70.

Sometimes (Plate XXIV. 5) the stones show horseshoe-shaped grooves on opposite faces, by means of which ropes could be attached for raising them; sometimes a hole of the same form is hollowed in the stone to permit the insertion of the rope for the same purpose. Again, a mortise, widening at the bottom, reveals the use of the ingenious system of wedges which the moderns use under the name of "lewis" to fasten the ropes to the stones; or else two holes drilled near together seemed placed to give a hold for a sort of tongs or chain lewis mentioned by Vitruvius as among the implements used for handling stones.[1]

These indications alone reveal to us a whole series of machines, more or less well made, but which may have differed essentially from those which we use at present. Thus the use of the lewis implies the use of ropes and of pulleys, fixed either to special masts or to scaffolding; and the size of the masses moved by the ancients gives us reason to believe that the pulleys were arranged so as to increase the power by lessening the movement. Moreover, the texts are precise; we find the principle of pulleys and tackle shown in the theoretic works of the ancient Greeks; and Vitruvius[2] in the first century before our era indicated in his treatise cranes, the different kinds of rigging for them, combinations of cranes, and windlasses, capstans, sheers, etc., all with such clearness and precision that in going over the first chapters of his tenth book one seems to be reading a treatise on modern hoisting machines. It is useless to describe under the names the Romans gave them the apparatus which we daily see in use; and I will limit myself, in concluding, to a general observation.

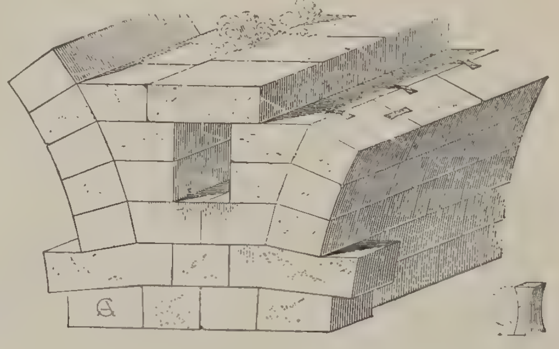


FIG. 71.

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[1] For example, a passage of Pliny, relating to the lintels and architraves of the temple of Ephesus (Hist. Nat. XXXVI. 21). The passage is very obscure; but one can at least distinguish in it a reference to an inclined plane (*mollis clivus*) made of sacks of sand; the stones of the architrave were dragged up this slope, and, after being raised a little above their supports, were lowered on them by letting the sand run slowly from the sacks.

[1] "*Ferrei forfices quorum dentes in saxa forata accommodantur.*" (Lib. X. cap. 2.)

[2] Arist., Mechan. cap. xix. One can get an exact enough idea of the chapters of Vitruvius relative to hoisting machines from Perrault's translation. The commentary is far from being irreproachable, but the figures which accompany it give the sense of the text so faithfully that it seems useless to give here a new interpretation.

When the edifice being built reached such a height that a derrick resting on the ground was not high enough to raise the stones the Romans avoided as far as possible the erection of those great scaffoldings that gives one the idea of one building enveloped in another. True to their principle of reducing the auxiliary work, they built stagings carried on corbels, which were moved as the building rose. This was the case at the bridge of Narni, the aqueduct of Gard. . . . The isolated corbels, projecting from the faces of the piers and tympanums, show plainly the conception of these movable stagings. Nothing is more simple to imagine than a sort of crane that rested on the projections; once the inner end of the corbels were built in, they would be quite stable enough to carry it, and it would be in no way cumbersome, and could easily be moved. It is sufficient to get an idea of the principle and its advantages; in studying the arrangement of the corbels, the details and essential characteristics of its applications could be discovered; but I wish to abstain from advancing a hypothesis where theory would perhaps have too large a place. I will keep to generalities on the practical methods of cut stone construction in ancient times, so there remains to be studied but the two principal subjects, monolithic lintels and keyed arches.

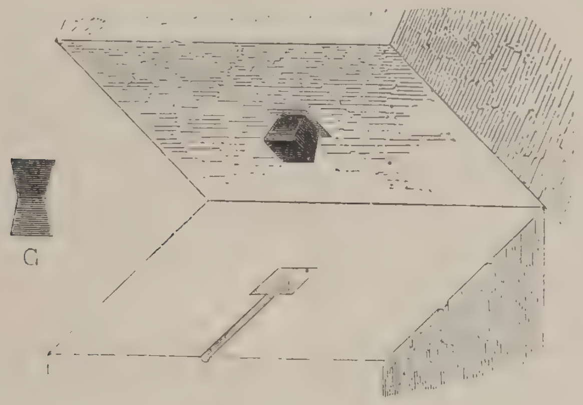


FIG. 72.

(*To be continued.*)

COLORING ARCHITECTURAL TERRA-COTTA.

THERE is no device resorted to by the clay-worker that is alike so inartistic and so ineffectual as attempting to give to architectural terra-cotta blocks a finer color than they naturally possess. The coating of such blocks with pigments or washes or the staining of their surfaces is never of a lasting nature; it soon wears off under the combined action of rain, smoke, frost, and other influences of an atmospheric nature.

"Then what are we to do if our clay will not yield a good color?" some may say. Well, the only course open is to determine whether it is admissible to use chemicals in the composition of the blocks, so that increased tone of color shall be due, not to a superficial film, but to the mass itself. Obviously, this will be governed entirely by (1) the cost of the chemicals, (2) the facility with which they can be applied; and these conditions, again, will be governed by the price which can be got for the goods.

If the selling price warrants the expenditure of labor and chemicals, by all means color the mass throughout; but if, on the other hand, the extra labor and expense would not be recouped, it is clear that the best course to adopt is to abandon the manufacture of the blocks, for which the particular clay is obviously unsuited, and exploit the clay for other purposes.

Washes and stains, however, are never permanent, and permanence is the first quality that is demanded in architectural facings. If these principles were more often present in the minds of clay-workers, we should not see so many ghastly failures in our streets, failures which only tend to bring our industry into disrepute.—*British Clay-worker.*

EARLY GERMAN BRICKWORK.

IN the early examples of the brick style the more elaborate parts, including the tracery of the windows and other molded work, were executed in stone. Horizontal bands of stone were also occasionally introduced, and they have a good effect in tying together the different part of the composition, besides their value in a constructive point of view. But in the later examples, from the end of the fourteenth century, stone is entirely dispensed with, and we find even such parts as crockets and finials executed in brick. The use of dark brown or black glazed bricks was also common during the later period. The character of the moldings varies, of course, somewhat in the different periods, being simpler in the earlier and more elaborately subdivided in the later. Delicacy of profile can hardly be expected from the nature of the material. Molded bricks were also used to make up general forms, such as circular piers, the inner side of circular turrets, etc. There are a few points in the construction of the buildings which ought not to be passed over. There is usually a granite plinth carried all round the churches, and the towers are faced with the same several feet up. The absence of buttresses to the towers rendered it necessary to increase the thickness of the walls, which we find is very considerable, notwithstanding which they mostly incline from the upright, and it is remarkable that this occurs most frequently towards the southwest. The mortar joints are invariably very wide (from ½ in. to ¾ in., or even more); the mortar itself is extremely hard. The construction of vaulting claims particular attention. In the first place, a light material was prepared in bricks, molded of a wedge form. The ribs seem to have been first constructed independently as a skeleton, and between them the spandrels were filled in with the light bricks, apparently without the use of centering, as each spandrel is considerably arched up to enable it to support its own or any superincumbent weight. Thus the vaulting rests entirely on the ribs, which are not tailed into it. It is a single brick in thickness, about 6 ins., and is backed up only a very short distance above the springing, so that the form is very distinctly seen on the upper surface, where it presents a very remarkable appearance. The bond used throughout is the Flemish, or, as it is now called, the crossbond. The arches are always built in half-brick rings. The bricks used in the buildings are of a larger size than those now commonly used in Germany. They are remarkably hard and sound, and are rather heavy; though externally of a brown-red color, the inside is gray, like our stocks. This is not the case with those now made. The light vaulting bricks were made with a mixture of chopped straw, so that when burnt they were porous, but of sufficient strength for their purpose. The first-class bricks, as a material, are superior to those used in this country; the color uniformly red, except where a vitreous action had been produced in the burning. There did not appear to have been a rubbing down of the face of the material when used for mullions or tracery; the ordinary examples presented too rude a surface to suppose such an operation.

EXHIBITION OF THE CITY HOUSE COMPETITION DRAWINGS.

WE have selected twenty-five sets of the drawings submitted in the City House Competition for exhibition in the larger cities of the country.

These drawings have been very neatly mounted on binder's board, size, 20 by 30 ins., and all prepared for hanging.

The drawings selected are pronounced by the judges as being of a high order and most interesting character, and well worth exhibiting.

Arrangements have already been completed to exhibit the drawings in Boston, New York, and Philadelphia. We should be glad to make similar arrangements with clubs in other cities. Dates for exhibiting will be made in the order in which the applications are received. The drawings will be sent in a case specially prepared for the purpose, and all transportation charges will be prepaid.

ARCHITECTURAL TERRA-COTTA.

BY THOMAS CUSACK.

(*Continued.*)

SANTA MARIA DEL CARMINE of Pavia, built in the fourteenth century, shows the influence of the Gothic, which in Northern and Western Europe had ere this reached its zenith. The windows are filled with tracery, and the great rose window is surrounded with a number of little faces and figures modeled in terra-cotta, and alternating with cabled and dentiled moldings, all relics of the earlier Romanesque. The interior columns and piers are constructed of terracotta bricks, and, "notwithstanding their thousands of component pieces," says the writer already quoted, "their shape appears faultlessly cylindrical, and so neatly are they fitted and jointed together, that it is only on very close inspection that the joints become distinguishable, and not even so much as a penknife can be inserted between brick and brick."

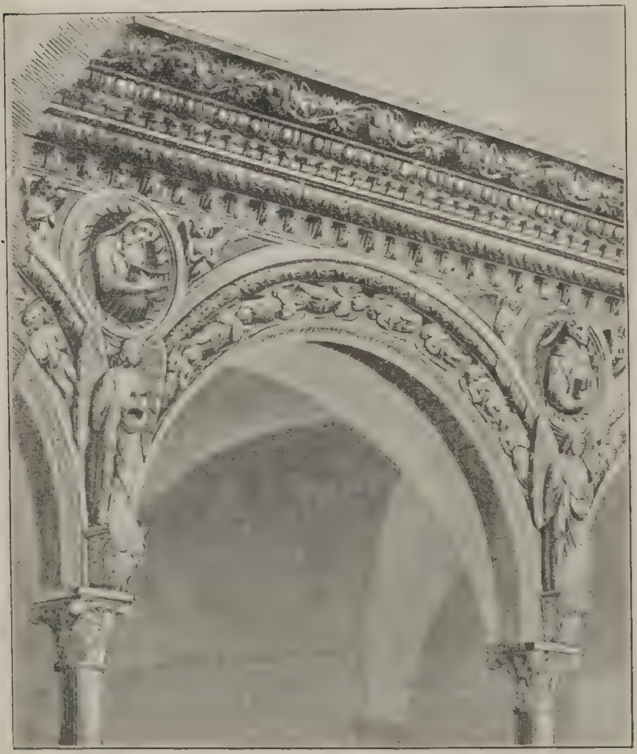
Good use was evidently made of the tax imposed upon widowers contracting a second marriage, from the proceeds of which it seems that the church was erected. Much better this, though doubtlessly less popular, than our plan "of setting 'em up for de boys."

The Cathedral of Crema, built early in the fourteenth century, has rounded as well as pointed arches, filled with delicate tracery, in the details of which no two windows are alike, yet with sufficient kinship to secure harmony, just as Pope has it: —

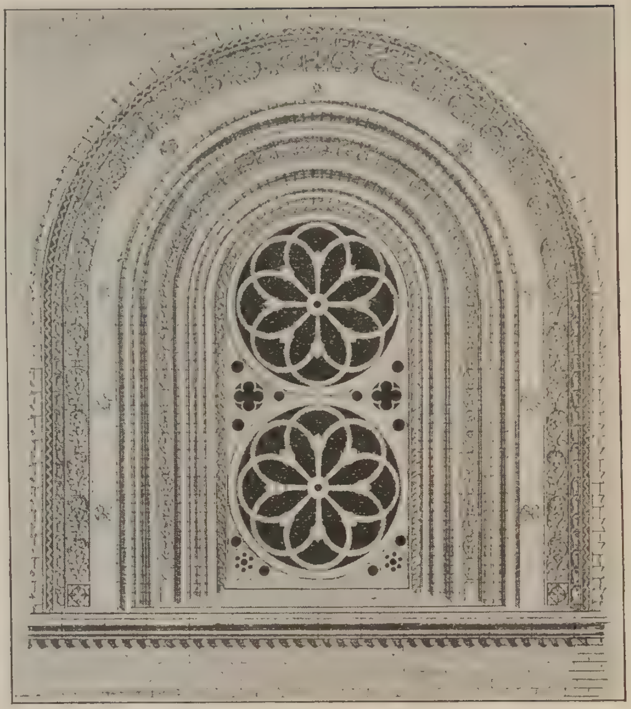
> "Where order in variety we see
> And where though all things differ all agree."

Space will permit of but one example, and the same reason may be given for restricting our reference to all save the most typical of the structures now under consideration, in this veritable home of what might be extended into a volume, entitled Brick and Terracotta in the Middle Ages.

The foliated ornament is also varied, in every window of Crema, showing that the artist was able to resist the temptation to make a commercial use of a set of molds, and that he abhorred a tiresome repetition of the same patterns, as much as nature does a vacuum. The same remark will apply to the capitals in the arcading of the pediment, which forms a characteristic feature in all Lombard work. The color in this case is a light orange, of which Mr. Lose says he has "as yet seen no second specimen," adding, "of all the edifices I know, this displays the best and most careful workmanship. Close inspection is necessary to discover how much precision, skill, and finish have been bestowed on those figures and that foliage, which to-day remains as if newly wrought."



ARCADE FROM CLOISTERS, CERTOSA PAVIA.



WINDOW, CATHEDRAL OF CREMA.

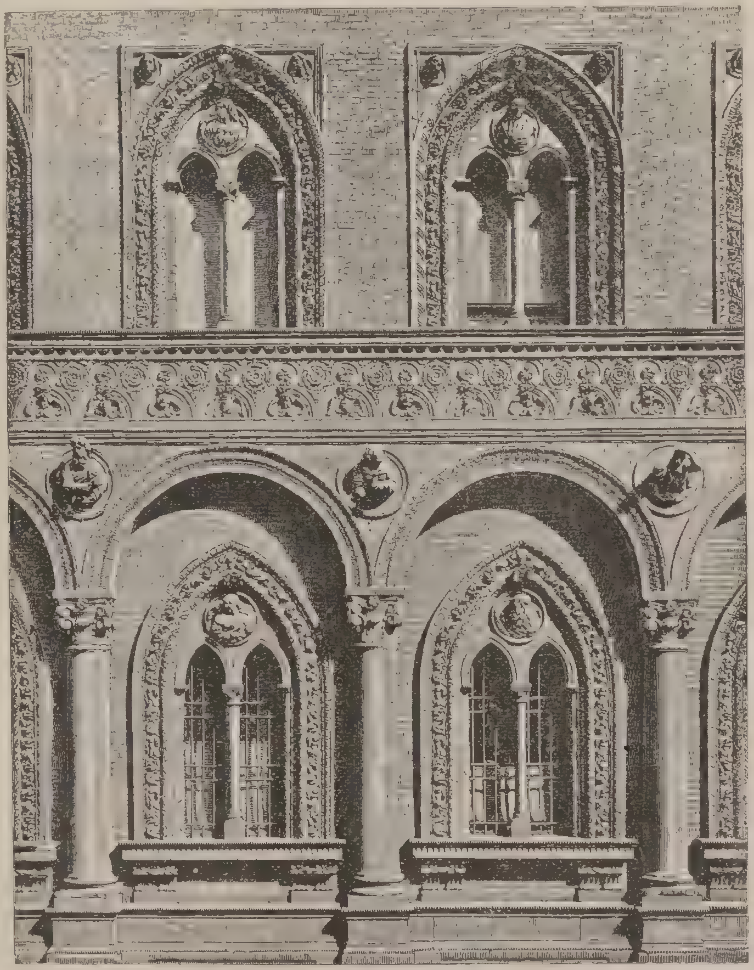
In the church of San Rustico at Caravaggio we have a good type of the Lombard, in which effect is obtained by strong architectural lines, and hooded niches for figure sculpture, without tracery or foliage. The adjoining campanile with panels, pilasters, stringcourses, and cornices, all in brick, indicates a reversion to classical precedents.

The famous Certosa of Pavia which an ancient historian has described as "the finest beyond all others" covers a parallelogram of about 420 by 330 ft. It is surrounded on three sides by a cloister of 123 arches, of which we give a general perspective and illustrations of two arches. A full-size replica of one bay has been added to the casts of the Metropolitan Museum of Art, New York. It will be found suspended underneath "Diana's Hunting Party," where, fortunately, we were able to recognize it without the aid of a catalogue, the prolonged absence of which renders the Willard Collection of Architectural Casts less instructive, and, indeed, goes far to defeat the object of its donors. Each spandril medallion frames the bust of a saint or father of the church portrayed in some act of devotion. The allegorical figures have slightly varied poses and expressions, which Wordsworth might have described as a "similitude in dissimilitude." The grape-vines have not been unduly conventionalized, and the troops of little images around the arches look as if they all had been specially modeled, or, if not, they must each have received their individuality after leaving the mold. The prolific fancy of the artist must have been allowed free scope for tangible expression here, and, to his credit be it said, the ductility of the material in which he worked did not lead him into grotesqueries or unbecoming vagaries. The general view of this composite work of architecture, science, and art, shows that the massing of the whole group was in the hands of a master. We doubt whether a more striking example of scenic and picturesque effect can be instanced from among similar works of mediæval or modern architecture. This is subject to the exception of the western façade, which was added about a century later, and has been severely condemned by Street, and other far less exacting critics. The original pile of glowing red brick and terra-cotta does not greatly suffer in this connection, however. The magnificent mongrel designed by painter Borgognone is in marble and precious stones, producing "a gorgeous richness," which Leader Scott thinks "better not to analyze too closely." This same art critic is, on the other hand, loud in his praise of "the exquisite terra-cotta decorations." But the application of architectural terra-cotta had here touched its high-water mark. The Cinquecento school led the way to lower stages of decline and degeneracy, culminating in bizarre and inartistic rococo, and with it terra-cotta disappeared in Italy until its revival in the present century.

The towers and campaniles built of brick and terra-cotta are a distinguishing feature of mediæval architecture in Italy. Viewed from a distance, they stand in the same relation to the skyline of an Italian city, as do the minarets to Stamboul or Constantinople. In time they came to be so plentiful, and remained so uniformly firm and erect, that certain architects exhibited a wild craving for something that would be novel, if not altogether original. Goethe tells us that "every man wished to make a show with a tower, and at last straight towers became so commonplace that leaning towers were erected" by way of contrast and distinction. Whether intentional or not we need not stop to inquire, but certain it is that Bologna is the proud possessor of two of these. Her architects, however, have done something to atone for these eccentricities, or faulty foundations, as the case may be, by giving us many good specimens of brick and terra-cotta, one of which is the Palace of Fibbia.

The Castle of Pavia was erected in the fourteenth century by the all powerful Duke of Milan. It inclosed an immense quadrangle, on three sides of which were Gothic arches on the first story, and a combination of Gothic and Romanesque arcading on the second, chiefly in brick and terra-cotta. Brentano informs us that "this range of buildings was of capacity sufficient to lodge the court of any king or emperor whatsoever." It has long been a ruin, however, and but little of it now remains to mark the place of the once magnificent edifice. This was not due to any deficiency on the part of the materials of which it was built; but thereon hangs a tale, and, briefly, it is as follows: In 1527 Italy had been turned into a sanguinary battlefield between Francis I., whose armies had crossed the Alps to meet those of Charles V., already in possession of the country. The conflict between these two monarchs seems to have been fomented by the intrigues of Wolsey, who was particularly anxious to obtain the popedom; and on its result depended another important question, viz.: whether his master, Henry VIII. of England, would obtain his divorce from the aunt of Charles, Catherine of Arragon. Needless to say that these issues were weighty and far reaching, but we are concerned here, only with the immediate consequence, which, though trivial by comparison, was very disastrous to the Castle of Pavia. According to the authority just quoted, "This palace had four great towers, but now there remain only two towards the city; the other two were broken down by the artillery of Gascon Lautrec."

Among other secular buildings almost wholly of brick and terra-cotta, the great Ospedale Maggiore, Milan, heads the list of those in Italy. And with it we must hasten onward in our rapid summary to other lands where these materials have been, and are still used profitably and with good effect, owing in no small degree to Italian example and inspiration. Architecturally, it is one of the few instances where Gothic, Romanesque, and early Renaissance features have been successfully blended, without producing a hybrid such as the western façade of the Certosa of Pavia. Carl Von Lutzow, in his "Art Treasures of Italy," says that "brick architecture has scarcely produced another building of equal beauty; nor has anything more decorative been executed in terra-cotta than these two stories, with their pointed windows divided by columns, the rich plastic garlands which surround them, and the effective medallion heads which ornament the building." The oldest portion was built about the middle of the fifteenth century, and is credited to the Florentine architect, sculptor, and author, Filarete. He, like his more famous countrymen, Brunelleschi and Michael Angelo, was no mere picture-maker on paper, whose tools of trade are limited to a pencil, rule, and tee-square. He belonged to the famous school of mediæval "master masons," who, confined to no country, labored in Italy, Germany, France, and England, before Art — at the instance of "the profession" — was divorced from Industry, to the irreparable loss of both. In each of these countries their work remains in an enduring form, and the inscription in St. Paul's over the grave of Wren might with equal propriety, but in a still wider sense, be applied to them also. "*Si quæras monumentum circumspice.*" These four words — to transpose Walpole — would comprehend their merit and their fame.



PORTION OF THE FACADE OF THE OSPEDALE MAGGIORE, MILAN.

The late Mr. Street was an artist beyond doubt, but he did not care to have his beloved thirteenth century Gothic mixed with anything. He preferred it straight and uncompromisingly pointed, as in the New Law Courts. Yet in a foot-note to the 1855 edition of his "Brick and Marble," etc., he makes graceful apology for not having seen the Ospedale Maggiore during his first hurried visit to Northern Italy. The terra-cotta on this building is applied so effectively and with such an evident knowledge and appreciation of its character and capabilities, that it, in common with other examples to which reference has been made, might be studied with profit by many of our own architects.

(*To be continued.*)

Fire-proofing Department.

Conducted in the Interest of Building Construction to Prevent Loss by Fire.

FIRE-PROOF FLOOR ARCHES.

BY GEORGE HILL, C. E.

PUBLISHED TESTS.

AUSTRIAN SOCIETY TESTS. — CONTINUED.

WITH regard to the matter of the cost, it may be said that flat arches are always naturally somewhat more expensive than arches built of ordinary bricks; they also require a deeper layer of cinders, concrete, etc., to bring them level with the top of the floor beams, especially where the width between skew-backs requires deep sections. However, the fact of their giving flat ceilings without extra work will make them preferable to brick arches of $\frac{1}{10}$ rise in very many cases.

Medium Spans. Every arch of the second series sprung between I beams with a span of 8 ft. 10.2 ins. was tested to failure, as it was possible to apply eccentric loading here.

Table B gives all necessary data regarding the changes which the arches underwent as each successive load was applied; the horizontal deflections of the crown recorded are, of course, to be taken in the direction of the unloaded segment of the arch.

The arch composed of ordinary bricks in white lime mortar was able to carry a load of 885 lbs. per square foot before it failed, which just about corresponded with the ultimate load assumed; under an eccentric loading of up to 409.6 lbs. per square foot it gave evidence of but very little change. Such arches, therefore, satisfy most requirements put to them in ordinary architectural construction.

The opportunity was here taken to investigate whether or not a shallower arch, say about 3⅜ ins. thick, would answer the same purpose. Inasmuch as bricks of that size are not being manufactured now, an arch was built of "Hönel's" bricks, giving it a rise of 1 : 20, which can be considered great for flat arches. The hoped for result was, however, not attained, as the arch failed under an eccentric load of 491 lbs. per square foot, after having shown considerable deflection beforehand. It does not seem advisable, therefore, to depart from the dimensions which have come to be adopted in practical work, namely: a thickness of 5⅞ ins. and a rise of 1 to 10. The arch of concrete $3\frac{5}{16}$ ins. thick, composition in the ratio of 1 : 4, has fulfilled all requirements, inasmuch as it began to crack appreciably only under a load of 614.4 lbs. and failed under an eccentric load of 1,130 lbs. per square foot. (See Fig. 24.)

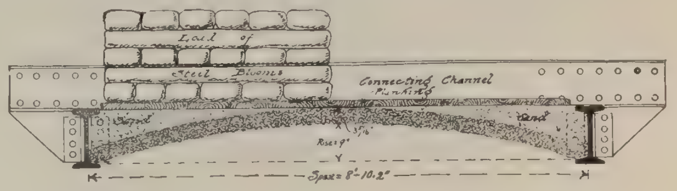


FIG 24 – SECTION OF CONCRETE ARCH

The deflections of the crown were uniformly lesser than in the case of either the brick arches or those of corrugated iron.

The two Monier arches deflected, on an average, equally as much as the concrete arches; and, all in all, these two systems do not show any great difference.

The ultimate load for the ideal Monier arch (Fig. 25), using cinders and planking, was equal to 1,220 lbs. per square foot; for the Monier arch, leveled up with concrete (see Fig. 26), however, 1,320 lbs. per square foot, an increase of 8 per cent. Contrary to this, the ratio of the consumption of concrete in these two cases is 1 : 1.85; so that, from a practical point of view, the second method is in no way superior to the first, as the leveling up with concrete cannot be regarded as an increment of strength, but simply as an equivalent for the layer of cinders, an agent in the distribution of the load.

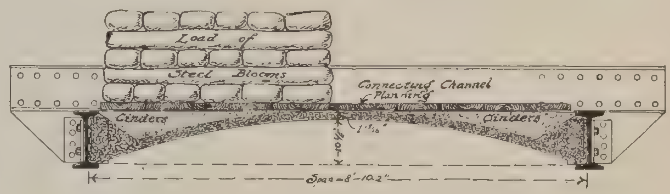


FIG. 25 – SECTION OF MONIER ARCH

This assertion can also be proved by pointing to the action of the arch while under load, for as this was successively increased the real body of the arch separated entirely from the superficial layer of concrete, although this had been applied immediately after the arch

TABLE B. ARCHES OF 8 FT. 10.2 INS. SPAN.

Number of load.	Load uniformly distributed on one half of arch, in pounds per square foot.	Movements of the crown in inches downward vertically laterally.						
		66	67	68	69	70	71	72
		Concrete arch. Fig. 24.	Monier arch.		Arch built of ordinary bricks.	Arch built of Hönel's bricks.	Corrugated iron.	
			Plain arch. Fig. 25.	Leveled up with concrete Fig. 26.			Without reenforcement.	With reenforcement of the edges.
1	102.4	0.0433 0.00786	0.0394 0 0118	0.0315 0.00394	0.067 0.01575	0.0552 0.00786	0.1141 0.0197	0.1731 0.0118
2	204.8	0.0945 0.01575	0.0788 0.0197	0.0708 0.00786	0.197 0.0591	0.366 0.00786	0.2361 0.0197	0.311 0.0236
3	307.2	0.1695 0.0394	0 1575 0.0394	0.130 0.0236	0.335 0.1023	0.721 0.149	0.3462 0.02759	0.382 0.03145
4	409.6	0.244 0.0708	0 2361 0.0591	0.193 0.0315	0.513 0.1575	1.439 0.288	0.4419 0.0394	0.461 0.0433
5	512.0	0.335 0.114	0 335 0 0826	0.279 0.0513	0.767 0.209		0.598 0.0513	0.532 0 063
6	614.4	0.422 0.1575	0.426 0 110	0.374 0.0749	1.083 0.252		0.74 0.0669	0 618 0.0708
7	716.8	0.532 0.205	0.561 0.134	0.468 0.105	1.472 0.307		0.901 0.866	0.713 0.0826
8	819.2	0.642 0.252	0.669 0.165	0.555 0.142	2.079 0.394		1.06 0.1181	0.808 0.0905
9	921.6	0.791 0.311	0.798 0.224	0.708 0.185			? ?	0.968 0.105
10	1,024.0	0.95 0.378	1.015 0 279	0.863 0.236				1.15 1.18
11	1,126.4	? ?	? ?	1.049 0.291				
12	1,331.2			1.223 0.346				

Remarks and enumerations of ultimate loads.						
Concrete arch.	Monier arch.		Arch of ordinary bricks.	Arch of Hönel's bricks.	Corrugated iron.	
	Arch alone.	Arch with concrete filling.			Simple.	Reenforced.
Thickness at crown 3⅜ ins., rise 9.05 ins., weight of arch 3,140 lbs., cinders and planking 1,349 lbs. Re 2) horizontal fissure in the unloaded half, re 6) crack at abutment. Failure of the arch under 1,109 lbs. per square foot, one half of arch being loaded.	Thickness at crown $1\frac{15}{16}$ ins., rise 10¼ ins., dead weight 2,460 lbs., cinders and planking 1,355 lbs. Failure of the arch under 1,217 lbs. per square foot, one half of arch being loaded.	Thickness at crown 2⅛ ins., rise 10¼ ins., weight 5,420 lbs. Re 10) longitudinal crack near crown. Failure of the arch under 1,320 lbs. per square foot, eccentric load.	Thickness at crown 5½ ins., rise 9.85 ins., weight 2,680 lbs., cinders and planking 1,500 lbs. Re 7) horizontal fissure over the entire unloaded half. Failure of the arch under 885 lbs. per square foot, eccentric load.	Thickness at crown $3\frac{15}{16}$ ins., rise $5\frac{5}{16}$ ins., dead weight 1,191 lbs., cinders and planking 1,138 lbs. Re 2) crack in the loaded half, 9.85 ins. from the crown. Failure of the arch under 491 lbs. per square foot, eccentric load.	Corrugated iron, type 3.5 ins. by 1.9 ins. by .039 in. Rise 9.85 ins., weight 143.5 lbs., cinders and planking 1,685 lbs. Failure under 975 lbs. per square foot, eccentric load. The ends very much bent and injured.	Corrugated iron, 3.5 ins. by 1.9 ins. by .039 in., reenforced with angle irons 2.36 ins. by 2.36 ins. by 0.236 in. Weight 198.5 lbs., cinders and planking 1,775 lbs., rise 10¼ ins. Failure under 1,099 lbs. per square foot, eccentric load.

itself had been built. By the use of such a leveling up of concrete, it is undoubtedly possible to get along with shallower beams, and generally to decrease the dead-weight; but the strength of the arch is not essentially increased.

Compared with the arches of concrete, the Monier system has shown only a slightly higher carrying capacity; this difference, from a practical point of view, may be said to be of no consequence.

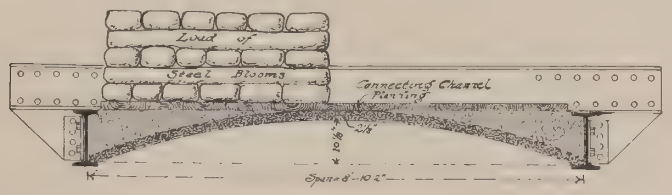


FIG 26 – SECTION OF MONIER ARCH
LEVELED UP WITH CONCRETE

We may, therefore, conclude from these tests that a slightly thicker arch of concrete is very well adapted for replacing the Monier arch.

In the case of the two spans of corrugated iron (type 3½ ins. by 1.97 ins. by .39 in.), the one was placed directly between the skew-backs, while the other was protected by angle irons (2.3 ins. by 2.3 ins. by $\frac{7}{32}$ in.), which were riveted to its edges to prevent any incidental deformations; the plain piece failed under an eccentric load of 975 lbs. per square foot, while the reenforced sample failed under a similar load of 1,100 lbs. per square foot, so that the ultimate loads were as 1 : 1.13. Assuming these samples to be equivalent to a hinged arch, and calculating accordingly, we find the first to have a fibre strain of 46,200 lbs., and the second 55,000 lbs. per square inch; as this latter amount is quite equivalent to the ultimate strength of soft wrought iron, we are justified in concluding that the reenforcement by means of angles is necessary to make the action that of a hinged arch. As a matter of fact, the corrugated iron so reenforced gave evidence of hardly any deformation whatsoever at the abutments, while, in the case of the plain piece, both the upper and lower arcs of the curved ribs had been very much bent, thereby naturally decreasing the carrying capacity of the arch considerably.

The vertical deflection at the crown was very much greater in both cases than that of either the Monier or the concrete.

TABLE C. DEFORMATIONS OF ARCHES OF A SPAN OF 13 FT. 3.6 INS.

MONIER ARCHES.—FIG. 29–73.

Number of load.	Eccentric load in pounds per square foot.	(v-Vertical.)		Recorded Deflections in inches.						(h-Horizontal.)		Rotation of cross-section (in degrees, minutes, and seconds) at the points:			REMARKS.
		1		2		3		4		5		2	3	4	
		v	h	v	h	v	h	v	h	v	h				
1	102.40	+.00394	.00394	+.00788	.0118	0.0236	.0118	.0394	.00788	.00788	.00788	−0′ 15″	−3′ 46″	+2′ 00″	Thickness at crown $1\frac{15}{16}$ ins., rise $15\frac{1}{2}$ ins., weight 2,215 lbs., cinders and planking 4,160 lbs. Re 4) crack at abutment, re 5) second crack in unloaded half. Failure under 895 lbs. per square foot, re 9) after $2\frac{1}{2}$ hours.
2	204.80	+.0079	.0079	+.0197	.0236	0.0512	.0236	.0749	.01576	.0118	.0118	−0′ 30″	−7′ 55″	+3′ 54″	
3	307.20	+.01576	.0236	+.0276	.0394	.0984	.0434	.1575	.0276	.0197	.0197	−2′ 00″	−14′ 25″	+7′ 00″	
4	409.60	+.0236	.0394	+.0434	.0788	.153	.0708	.256	.0434	.0315	.0315	−2′ 47″	−23′ 36″	+10′ 44″	
5	512.00	+.0433	.08275	+.0905	.138	.236	.110	.414	.0787	.04725	.04725	+0′ 55″	−42′ 07″	+17′ 00″	
6	614.40	+.0552	.1379	+.138	.181	.326	.153	.563	.118	.0699	.059	+3′ 16″	−59′ 10″	+22′ 27″	
7	716.80	+.0708	.1890	+.1695	.232	.422	.232	.704	.149	.0826	.063	+4′ 09″	−1,014′ 00″	+26′ 48″	
8	822.68	+.1340	3.3900	+.299	.386	.769	.314	1.15	.2615	.124	.067	+7′ 10″	−1,052′ 40″	+43′ 00″	
9		+.1930	4.5250	+.398	.505	1.08	.386	1.405	.306	.146	.0787				

CONCRETE ARCHES.—FIG. 18–73a.

Number of load.	Eccentric load in pounds per square foot.	(v-Vertical.)		Recorded Deflections in inches.						(h-Horizontal.)		Rotation of cross-section (in degrees, minutes, and seconds) at the points.			REMARKS.
		1		2		3		4		5		2	3	4	
		v	h	v	h	v	h	v	h	v	h				
1	102.40	+.00394	0.0	+.00394	.00394	.0118	0.0	.0118	0.0	.00394	0.0	−0′ 45″	−0′ 40″	+1′ 00″	Thickness at crown $3\frac{15}{16}$ ins., rise $15\frac{7}{8}$ ins., weight 4,420 lbs., cinders and planking 4,560 lbs. Re 4) crack—entire length of arch—at abutment. Failure under a load of 812 lbs. per square foot
2	204.80	+.0079	0.0	+.0079	.0079	.0276	.00394	.0236	.00394	.0079	.00394	−1′ 35″	−1′ 30″	+2′ 15″	
3	307.20	+.01576	.00394	+.0079	.0197	.0708	.0197	.0943	.0118	.0079	.01575	−3′ 35″	−5′ 50″	+7′ 50″	
4	409.60	+.0197	.0079	+.0118	.04725	.1140	.0394	.1690	.0197	.0118	.0236	−5′ 40″	−10′ 30″	+13′ 40″	
5	512.00	+.0394	.0669	+.00394	.0945	.1695	.0708	.2920	.03914	0197	.0394	−8′ 55″	−14′ 20″	+23′ 45″	
6	614.40	+.0669	.149	−.079	.177	.2130	.138	.532	.0866	.0236	.0631				
7	662.00	+.0787	.197	−.146	.197	.2280	.177	.656	.118	.0276	.0788				

BRICK ARCHES.—FIG. 28–74.

Number of load.	Eccentric load in pounds per square foot.	(v-Vertical.)		Recorded Deflections in inches.						(h-Horizontal.)		Rotation of cross-section (in degrees, minutes, and seconds) at the points.			REMARKS.
		1		2		3		4		5		2	3	4	
		v	h	v	h	v	h	v	h	v	h				
1	102.40	+.0079	.0118	+.1615	.0668	.157	.0512	.258	.056	.0079	.0079	−7′ 00″	−33′ 00″	+10′ 40″	Thickness $4\frac{7}{8}$ ins., rise 1,379 ins. Crack on the upper surface of one quarter of unloaded arch under 137.5 lbs. per square foot.
2	205.5	+.01577	.0236	+.390	.1505	.306	.117	.559	.133	.0118	.0158	−0′ 35″	−1° 12′ 55″	+14′ 35″	
3	274.1														

MELAN ARCH OF 13 FT. 11 INS. SPAN.—75.

Number of load.	Eccentric load in pounds per square foot.	(v-Vertical.)		Recorded Deflections in inches at the points.						(h-Horizontal.)		REMARKS.
		5		4		3		2		1		
		v	h	v	h	v	h	v	h	v	h	
1	102.4	0	.00394	.055	0.0	.0473	0.0	.0236	0.0	0.0	.00394	Thickness $3\frac{1}{8}$ ins., rise 11.4 ins., weight, 4,860 lbs., weight of eccentric sand leveling 1,549 lbs. Re 10) hair crack on under side of arch became visible, about 11.8 ins. long, near crown. This crack did not widen later on. Re 11) after a pause of 18 hours. The lateral deflections "h" to the right are recorded as negative. The vertical deflections "v" are taken with regard to a horizontal connecting the two points of abutment.
2	204.8	0	0.0	.106	0.18	.0944	0.00394	.0434	0.0	0.0	.00394	
3	307.2	0	0.0	.153	0.276	.1419	0.0236	0.0629	0.0197	0.0	.0236	
4	409.6	0	0.0	.2049	0.276	.189	0.0354	0.0709	0.0315	0.0	.0276	
5	0.0	0	−0.055	.0276	0.276	.0157	0.0354	0.0315	0.0118	0.0	.0197	
6	409.6	0	−0.0629	.173	0.866	.1615	0.0747	0.906	0.0433	0.0	.0557	
7	512.0	0	−0.06675	.232	0.906	.212	0.0747	0.1061	0.0512	0.0	.0473	
8	614.4	0	−0.0591	.276	0.945	.252	0.0826	0.118	0.0197	0.0	.0551	
9	819.2	0	−0.0591	4.09	0.134	.406	0.122	0.181	0.0433	0.0	.0866	
10	1024.0	0	−0.0473	5.58	0.1181	.548	0.1459	0.248	0.0708	0.0	.1062	
11	1024.0	0	−0.0748	6.13	0.983	.575	.1141	0.288	0 0394	0.0	.0513	
12	1228.8	0	−0.118	11.29	0.906	.674	.0945	0.319	0 0236	0.0	.0394	
13	1412.0	0	−0.0669	8.23	0.433	.790	.0512	0.382	0.0276	0.0	.0118	
14	0	0		.264	0.0236	.299	.0236	0.209	0.0905	0.0	.0513	

In point of cost, the latter two are very much more expensive than corrugated iron of the same carrying capacity, but this requires special treatment in case a ceiling is desired, which would, of course, add to the expense.

The three arches having stationary abutments, with a span of 13 ft. 3.6 ins. (Figs. 18, 28, and 29), had five rods fastened to them, one at each abutment, one at the crown, and one at one fourth of the span (see Fig. 27), the uprights and triangles belonging to each rod being finally added. At the last-mentioned points delicate levels were adjusted to measure any rotation of the cross-section. Table C contains all the results of these tests. It is evident from them that the carrying capacity of the brick arch was much too small, as tensile strains appeared which the mortar joints were incapable of resisting.

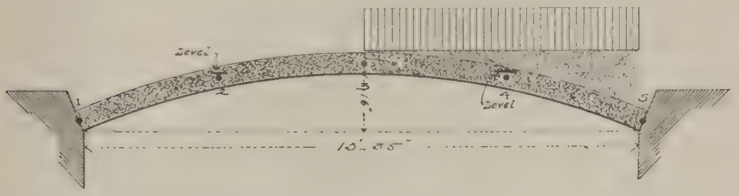


FIG. 27 — ARCH OF 13'-3.5 SPAN SHOWING DEFLECTION POINTS

The concrete arch (Fig. 18) failed under an eccentric load of 754 lbs. per square foot; the Monier arch under a similar one of 893 lbs. per square foot; so that these two arches fulfilled all that was expected of them, showing but a small difference in their respective ultimate loads. The first cracks appeared in both cases under a load of 614.40 lbs. per square foot; the deflections of the Monier arch were somewhat greater than those of the rammed concrete arch.

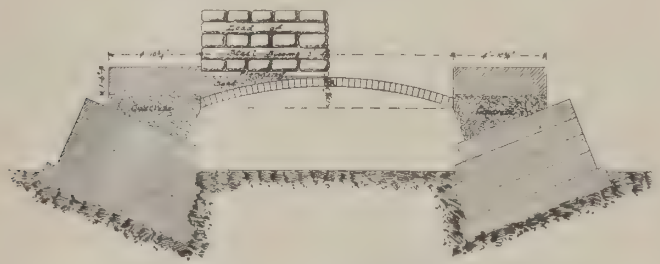


FIG. 28 - BRICK ARCH WITH MASONRY ABUTMENTS

From these tests, also, it will be seen that the concrete arches compare very favorably in all respects with the Monier system.

After all these tests had been made a new system appeared (the Melan patent), which proposed the reenforcement of concrete arches by means of curved iron ribs. That is to say, iron I beams, bent truly to the arc of the arch, are inserted at certain fixed distances, corresponding to the static conditions, and wedged — in the case of floors — between the beams.

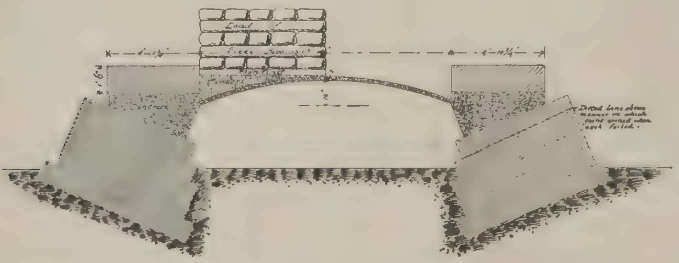


FIG. 29 - MONIER ARCH WITH MASONRY ABUTMENTS

After the concern manufacturing these arches,— Pittel & Brausewetter,— had made very satisfactory preliminary tests of the same, a sample was built at Brunn, during the month of July, 1892, and submitted to and tested by the committee a year later. This arch had a rise of 3 ft. 3.36 ins.; at a distance of every 3 ft. 3 ins. curved I beams, shape No. 8 (3⅛ ins. high), had been inserted.

The thickness of the arch was 3⅛ ins.; the average composition consisted of one part Radotiner Portland cement to five parts of sand and broken stones. Iron blooms were used as a load, after one half of the arch had received a leveling up of sand.

The vertical and horizontal deflections occasioned by the successive loads, at the crown as well as at the center of the loaded and unloaded segments of the arch, with regard to a horizontal passed through the abutments, are given in Table C; which table shows that this type of arch has a much greater carrying capacity than either the Monier or concrete arches of the same span.

On account of a lack of material, the loading was interrupted after 1,412 lbs. per square foot had been imposed; the permanent changes discovered after the removal of this load being very slight. In the further course of the test an area of 10,763 ft. over the second curved rib was loaded up to 36,200 lbs., at which point failure occurred, the fragments falling in the shape of a cone. Before this dangerous cracks and deflections had appeared under a load of 33,600 lbs.

Because it is evident from the manner of application of the load as just described that the carrying capacity of the curved rib entered more into the resistance than the concrete did, it will not be necessary to record the deflections at this point.

The first method of loading is, however, fully sufficient to characterize this system, because a load of 1,412 lbs. per square foot caused no appreciable deformations.

There can, therefore, be no doubt that this arch is eminently adapted for heavily loaded floors or bridges of small spans.

(*To be continued.*)

FIRE LOSSES FOR SIX MONTHS ENDING JUNE, 1895.

THE following is a comparison of the fire loss in the United States and Canada during June, 1895, with previous periods as made up by the *Journal of Commerce and Commercial Bulletin* from its daily records: —

	1893	1894	1895
January	$17,958,400	$10,568,400	$11,895,600
February	9,919,900	11,297,600	12,360,200
March	16,662,350	9,147,100	14,239,300
April	14,669,900	11,540,000	11,018,150
May	10,427,100	10,777,800	7,761,350
June	16,344,950	8,282,300	9,223,000
Total	$85,982,600	$61,613,200	$66,497,600

These figures, while showing an increase in the loss over 1894, show a most gratifying gain over the same period in 1893, and we do not doubt that fire-proof construction has contributed to this substantial decrease in loss, and yet in what a comparatively small portion of the building being done to-day are the best methods of fire-proof construction employed. A loss of more than $100,000,000 a year by fire is appalling and calls for the most serious consideration of our architects, who in turn should be backed up in their efforts for better construction by property owners and legislators.

FIRE-PROOFING COMPOUND.

A FIRE-PROOFING or fire-resisting mixture has been patented in Europe by a Mr. Debois, which is said to withstand the highest temperature. The material consists of quartz, silica, and sulphate of baryta, the proportions being varied according to circumstances. To this may be added sufficient pulverized puddingstone so that when moistened it has the consistency and plasticity of clay, and can be molded into any desired shape, dried, and burned. — *Brick.*

Mortars and Concrete Department.

Devoted to Advanced Methods of using Cements and Limes in Building Construction.

AMERICAN CEMENT.

BY URIAH CUMMINGS.

CHAPTER V. — *Continued.*

GYPSUM MORTARS.

THE mortar of the great Pyramid of Cheops, as shown by Dr. Wallace, Mr. Cresy, and others, is composed of hydrated sulphate of lime (gypsum), carbonate of lime, and clay.

According to Strabo, the walls of Tyre were built of stone set in gypsum, a very common material, apparently, in Asia Minor and the center of the old Assyrian civilization.

The composition of pure gypsum is as follows:

Sulphuric acid	46.52
Lime	32.55
Water	20.93
Total	100.00

When heated to 230 degs. Fahr. gypsum will part with its water of crystallization. It then becomes sulphate of lime, its composition consisting of sulphuric acid 58.84, lime 41.16 = 100. If then pulverized and mixed with water into a paste, it will quickly harden to a solid mass, becoming crystallized again by recombining with its equivalent of water.

But should the heat be carried above 320 degs. Fahr. it will no longer harden by admixture with water. It will not crystallize. The naturally occurring anhydrite behaves in the same manner when reduced to powder. Although in rock form it has a crystallization, it is very different from that of gypsum.

One part of sulphate of lime will dissolve in 400 parts of water.

One part of slaked lime will dissolve in 760 parts of water.

Silicate of lime, the basis of hydraulic cement, will not dissolve in water.

Sulphate of lime was extensively used by the ancient inhabitants of Mexico, as well as those of Egypt, in their masonry; also for exterior as well as interior plastering, and history bids fair to repeat itself, in some respects, at least, in the use of this material.

In several places in the Western States, and notably in Kansas and Texas, beds of impure gypsum are found of a soft, mudlike consistency. The impurities consist chiefly of clay. Within the past few years some of these deposits have been developed, resulting in the building up of a new industry that bids fair to become quite extensive.

The material is taken from the beds and heated sufficiently to expel the water of crystallization contained in the gypsum, the same operation, of course, expelling the moisture from the clay, upon which the substance falls into an impalpable powder. It is then ready for the market, and is sold for purposes of plastering. It has many advantages over common quicklime for such a purpose, as it sets quickly, becoming dry and hard in a short time. It carries sand largely, quite equaling quicklime in that respect, and, unlike the latter, it requires no hair in plastering.

These gypseous-clay beds were probably a mixture of clay and carbonate of lime, and in the condition of natural hydraulic cement rock. Subsequently, these rocks were subjected to the action of sulphuric acid, which expelled the carbonic acid, and itself combined with the lime, forming gypsum. The presence of the clay, in intimate contact with the gypsum, prevented the latter from hardening, as would have been the case had the gypsum been pure. The sulphuric acid was undoubtedly produced by the oxidation of iron pyrites or by the oxidation of sulphuretted hydrogen from sulphur springs in the neighborhood of the deposits.

The manufacturers of this gypseous-clay cement claim that it sets much harder than ordinary plaster of Paris (calcined gypsum), and attribute to it many features of excellence which cannot be attained by any admixture of pure plaster of Paris and sand.

It is possible that the heated clay may act somewhat in the nature of a pozzuolana, and by reason of its finely comminuted condition, and its intimate contact with the sulphate of lime, effects may be produced that are not possible with a mixture of sulphate of lime and sand.

The Agatite Cement Plaster Company, of Kansas City, Missouri, controls a bed of this material at or near Dillon, Kansas, which is estimated to contain about six million tons.

Prof. Edwin Walters, in a report on this material, says: —

"Agatite is of a light ash-gray color. Its natural consistency is about that of hard plastic clay. When calcined it assumes a pulverized form. When mixed with water it sets as does hydraulic lime or cement. There seems to be ample time between the mixing and the setting for the mortar to be applied to its intended use.

"A sample of several weeks' setting broke under a tensile strain of 370 lbs. to the square inch. It may be safely said that in both tensile and compressive strength agatite is fully one half that of the very best Portland cement under the Neat test and equal under the part sand test. It is superior in strength to most of the hydraulic limes and ordinary cements. But, inasmuch as agatite is intended for interior work, it is not necessary that it should be of such great strength. It is very much stronger than lime and sand plaster, which is its principal competitor.

"Agatite does not differ widely in composition from the cement taken from the famous Cheops Pyramid of Egypt. The Egyptian cement runs higher in sulphate of lime and lower in oxide of iron.

"It is very probable that a cement that would stand in the climate of Egypt would also prove durable in the United States.

"I only make the comparison to show that if the agatite is kept reasonably protected from frosts and excessive moisture that it would last for ages. It has splendid adhesive qualities. It will stick to wood, stone, or brick without the aid of hair or any other substance.

"It is not decomposed by any of the basic acids, however strong they may be. Alkalies do not affect it.

"Besides being a choice material for plastering walls and ceilings, it is admirably adapted to all kinds of interior finish. When in the plastic state it may be embossed, stippled, drawn, or molded. Any design in bas-relief may be executed if prompt action is taken after mixing. The time allowed for execution is much greater than that for stucco, unless the stucco is mixed with glue or some retarder that is likely to cause decomposition.

"Another superiority over stucco is its hardness. Not only does it allow much more time for execution, but it is very much harder after it sets.

"Paper may be applied to either one or two coat work for a finish. It is probable that one coat will be the best method. Paints may be added to agatite mortar to give any desired color, when paper is not desired. If a white finish is wished, a putty or stucco coat may be applied on the surface of the agatite.

"This material is adapted for wainscoting, interior arches, and segments for the back-filling and setting of tiles, for statuettes, etc., etc."

There would seem to be no doubt that gypsum plaster will find an extended use in the near future, and in a measure supplant the use of quicklime as a plastering material in interior work of much importance and magnitude.

It is doubtful, however, if it can ever be used for exterior work in Northern latitudes until some means are discovered for rendering it proof against the action of alternate freezing and thawing.

The climates of Egypt and Mexico are such as to permit the use of this material for exterior work, and there is no doubt but that it could be so used with safety in our Southern States on brick, stone, or wooden structures, and very pleasing architectural effects thereby produced at a comparatively slight cost. Sulphate of lime as a cementing agent has not as yet received the consideration due to its merits in this country. Heretofore it has been extensively used in interior decoration and for similar purposes, but there seems to have been no advance made in the direction of permanent exterior work. It was used as an outside covering of the walls of the World's Fair Buildings at Chicago, which, however, were temporary structures.

By adding 26.47 per cent. of its own weight of water to this material, it becomes so hard and firm that, made into a briquette of one inch square cross section, and given one hour in air and twenty-three hours in water, it will sustain a tensile strain of 250 lbs. before fracture. It can be produced in this country in colors ranging from black to snowy white, and by the admixture of the various shades of sand or clay most pleasing effects may be produced.

There are immense deposits of gypsum in this country, notably in the States of New York, Virginia, Ohio, Michigan, Iowa, Kansas, Arizona, California, Texas, Colorado, and Utah.

The production from the various deposits amounts to about 255,000 tons yearly. Approximately, 63 per cent. of this amount is calcined into plaster of Paris, and 37 per cent. is ground and used as a fertilizer.

The importation of gypsum rock amounts to about 184,000 tons yearly. Could some cheap and effectual process be found to render this material practically frost-proof, its use in exterior ornamentation would rapidly assume immense proportions, and its value as a building material would be almost incalculable.

(*To be continued.*)

THE EDITOR OF THE BRICKBUILDER:

Dear Sir, — In your last issue there was a letter from R. C. S., Jr., in regard to plaster work both with and without half timber.

I have had considerable experience with that sort of work in this country, having first used the material under the specification of an English plasterer who came to this country to make this work a specialty, introducing at the same time selenitic cement.

I have always used three-coat work, the first well-haired mortar and one third Portland cement, added when ready for use; this coat well scratched. The second coat the same, with the omission of the hair, and the third coat the same proportion, but with coarse sand or gravel, either floated or put on slap-dash, according to the kind of finish I wished to obtain.

I have occasionally used a very small quantity of ochre in this last coat, but it must be mixed very thoroughly and carefully in order to produce an even color.

This plaster work I have used on wood lath over stud without rough boarding behind it. Also on rough boarding with furrings and wood lath, which is better; and over rough boarding with furrings and wire lath, which is the best of all.

A small church plastered in this way on wood lath fourteen years ago is in perfect condition to-day, and various houses built during the last ten years have proved perfectly satisfactory. I have not as yet, however, found any method of building true half-timbered-work and making it thoroughly tight without making a wall that was practically as expensive as a brick wall.

I received two years ago from Mr. Peto, late of the firm of Ernest George & Peto, a couple of details showing the method which they used in England when they built real half-timbered-work. The studs were oak rebated to receive plaster or terra-cotta block. The outside plastering was on the face of the blocks, and the inside of the walls was furred so as to leave an air space, and then lathed and plastered. The construction, as you will see, is not a particularly inexpensive one.

Trusting that these few matters of experience may be of use to your correspondent, I am, Very truly yours, R. C. S.

THE ABUSE OF CEMENT.

FROM A PAPER READ BEFORE THE CANADIAN SOCIETY OF ENGINEERS.

BY D. B. BUTLER.

THE treatment which cement sometimes has to undergo at the hands of inexperienced users makes it a matter for wonder that failures are not more frequent. One of the most prolific causes of failure is insufficient attention to the setting properties of the cement under treatment. In very hot weather it is no uncommon thing for a cement to have a very quick initial set, and in using such a cement, therefore, in order to obtain its full strength, it must be mixed and in its allotted position within a very few minutes of adding the water. This often entails the mixing of very small quantities at a time, and, if due precautions are not taken, a larger quantity is mixed than can be manipulated before setting commences. This generally results in the use of additional water and the serious detriment, if not total destruction, of the setting properties of the cement. Many cases of failure have occurred in which the cement being a good quality, though somewhat quick setting, point strongly to over-manipulation or "killing."

Another frequent cause of unsatisfactory work is a dirty and unsuitable aggregate. The admixture of a very small proportion of dirt or loam is quite sufficient to materially deteriorate the strength of a concrete, and too much stress cannot be laid upon the necessity for seeing that all aggregates are free from any foreign dirty matter. A case of structural failure came under the notice of the author a short time back, in which the cement used was perfectly good, but the finer portions of the aggregate consisted of very fine sand, so fine that 60 per cent. passed through a sieve having 70 holes per lineal inch, and 80 per cent. through a sieve having 50 holes per lineal inch. The structure of which it formed part had to bear a considerable thrust, and to aggravate matters, instead of this sand being properly mixed, large patches occurred in which there was no cement at all. In addition to this, the sand contained a considerable portion of loam or foreign matter, and it is not to be wondered at that failure resulted.

The neglect of the proper cooling or aeration of a cement is a frequent cause of trouble, and, to ensure satisfactory work, proper cooling cannot be too strongly insisted upon. Of course cement may give good results when used hot from the mill, and the author has manufactured cement which has turned out satisfactorily under these conditions, but to use cement in this state is to court failure. It is sometimes specified that the manufacturer shall store the cement in his warehouse at a stated thickness of, say, three feet, for a certain period, and have it turned over three or four times at regular intervals before being supplied for use, but if this had to be done with the entire output of every factory, it would necessitate an enormous increase in warehouse room, to cover the first cost of which would entail a largely increased price to the consumer. It is, therefore, advisable, where cement is being used in considerable quantities, to construct temporary cooling sheds, with a good, dry, boarded floor, where the cement can be turned out in sacks or barrels and thoroughly aerated before use. It is sometimes contended that the cement, even if shipped hot, cools sufficiently during transit. Although it undoubtedly cools to a certain extent, it is doubtful if, when tightly packed in barrels, or closely stowed in sacks, it cools sufficiently to allow of its being immediately used with safety.

The exposure to extremes of temperature has, perhaps, more to answer for in the shape of unsatisfactory work than is generally recognized. If exposed to a summer sun immediately after being gauged, naturally a great deal of the necessary moisture is evaporated, leaving the cement without sufficient to complete the crystallization already set up. The result frequently is that the work crumbles and shows signs of failure. On the other hand, exposure to frost acts on the water, and by expansion destroys the surrounding concrete. The author once had occasion to investigate a case of failure in which frost was the undoubted cause of the mischief, as there was no fault to be found either with the cement, aggregate, or manner of manipulation. The concrete flooring of an outhouse in some new farm buildings was commenced late in December, and left partly completed, owing to the Christmas holiday. As frost set in with unusual severity during the interval, the work was not revisited until the return of milder weather, three or four weeks afterwards, when it was found that that portion which was laid immediately before the frost was utterly destroyed, while the proportion previously laid, which had sufficiently hardened to prevent total destruction, showed signs of flaking on the top where it had been floated or trowelled. In this case the cement had to bear the blame, although the destroyed portions, afterwards relaid with the same materials, gave perfectly satisfactory results. During severe weather, therefore, proper precautions should be taken to protect freshly laid concrete from the effects of frost.

To summarize the preceding remarks, the chief points requiring attention in the use of cement, in order to obtain the best results, are the following: (1) Sound, well-ground cement, of steadily increasing strength. (2) Due attention to the setting properties of the cement. (3) Clean, well-proportioned aggregate. (4) Proper maturing of the cement before use. (5) Protection from extremes of temperature. If these points always received the amount of attention due to their importance, failures in cement work, apart from defective design, would very rarely be heard of. — *Canadian Architect.*

EDITOR OF THE BRICKBUILDER:

Dear Sir, — The inquiry of R. C. S., Jr., in the July number, as to the best method of constructing stucco, mastic, etc., for half-timbered-work, brings to mind the fact that there is a wide field in a method of dwelling-house architecture which has long been neglected.

It is doubtful if there is any scheme of decoration which combines economy of cost with good practical results better than the old-fashioned half-timbered-work. It is almost what one might call a lost art, for it requires skill, and intelligence, and a good knowledge of materials to make a success of it.

There was some of this class of work done recently in this vicinity, and it consisted of three coats put onto wire lath. The final coat was a skim of half and half cement, with the result that in the course of a very short time the whole surface could be removed with a shovel. The work is, nevertheless, simple in character, and requires only a knowledge of the material and some experience in local conditions. The ordinary wire lath of a number of varieties is stretched between the wooden studs; this is plastered thoroughly with lime mortar mixed with a little Portland cement and a small amount of hair. This should be allowed to harden, the surface being well roughed. Upon this the outer coat of slap-dash should be thrown, the surface being first well wet. This coat may be composed of half cement and half coarse plasterer's sand, colored if desired; or of cement, sand, and fine stone or coarse pebbles to secure the rough effect desired. There should be no lime used in this outer coat, and the cement should be the best Portland. The sand should be coarse and sharp, and if from a beach should be well washed to get the salt out. Otherwise, there will be danger of the white efflorescence which is injurious to the appearance of the wall. A good effect may be secured by building a coarse-surfaced concrete wall and then plastering it with a mixture of one of cement to two or three of coarse sand, — the honeycombing of the concrete furnishing the best of keys. The mortar should be put on with a float and then rubbed down with a big wad of cloth to secure uniformity of surface. The board marks on a concrete wall may be in a large measure avoided by using good stock and beveling one edge of each board, so that when the boards swell from being wet the sharp edge of the beveled board will be jammed against the square edge of the adjoining board and thereby make a tight joint. This is a method much used by Mr. E. L. Ransome in his concrete walls. Great care should be taken to have the work done in the summer or spring, so that it may be well dried out and seasoned before the frosts come, for if there be moisture remaining in the work there is likely to be trouble. If this work is properly done there is no end to the field nor to the variety of its uses. It will last for scores of years in any climate, and may be seen in great quantities to-day in Canada, and all over Europe, and many parts of the States.

R. F. T.

HOW TO PREPARE MORTAR.

A RECENT number of *Engineering* contains an article by Edward Wolff, showing the proper as well as the defective methods of making mortar. Mr. Wolff says: —

"The slacking operation should be done in a water-tight box made of boards, and so much water should be mixed in that the contents will never get dry, and a sheet of water will remain on top to prevent access of air. If the box will not hold the entire quantity of lime required, the contents may be emptied into a cavity made in the ground close to the pan, and this process may be repeated. This should be done at least two weeks before sand is added, or before the mortar is prepared for use. Slackened lime prepared and kept as stated has been found free of carbonic acid after many years, air and gas not having been able to find access. Instead of following the procedure in slacking lime recommended above, we see in this country, or, at least, in the neighborhood of New York, a faulty process adopted, which consists in loosely mixing the sand with the slacking lime immediately after water has been added, and forming a dry heap on the surface of the ground, which is left lying there several weeks to give time for complete slacking before the sand is worked in evenly and the mortar considered ready for use. This heap arrangement is perfectly adapted to circulating air through a material which should be guarded against contact with air. The sun heats the surface of it, makes the air escape after it has given up its share of carbonic acid gas, while at the base of the heap and at the shady side a fresh supply enters to fill up the vacuum after it has circulated through the heap and has been robbed of its share of carbonic acid gas. That this procedure really happens in such a heap we can easily see when we place a lump of freshly slacked lime in a wineglass, and in another glass place a small quantity of material taken from a heap such as described, and which has been prepared a few days before; fill both glasses nearly up with water, and add a few drops of muriatic or sulphuric acid to each. In the first glass nothing can be observed, while in the second glass we will see in the shape of small bubbles the carbonic acid escape, which has been absorbed by the lime from the atmospheric air circulating in the heap."

A NUMBER of experiments on the adhesion of cement to brickwork have been carried out by Messrs. L. J. Affelder and R. C. Brown. Both natural and Portland cements were experimented with, several brands of the latter being tried. Three varieties of brick were used in the experiment, viz., a hard red brick having a specific gravity of 2.136, and absorbing 4.56 per cent. of water; a soft red brick having a specific gravity of 1.981, and absorbing 8.81 per cent. of water; and a firebrick having a specific gravity of 2.000, and absorbing 5.17 per cent. of water. The cemented surfaces of the bricks were 2¼ ins. square, and the joints were about ¼ in. thick. The results showed no definite relation between the adhesive and cohesive properties of the cements, but the general conclusion arrived at was that with Portland cement the adhesive power was at least one fifth of the cohesion, when new, and that in time it would have been fully equal to it. — *British Clay-worker.*

THE WAYLAND PORTLAND CEMENT COMPANY, Wayland, Steuben County, N. Y., has been incorporated by Valentine F. Whitmore, John N. Rauber, William Vicinus, of Rochester, and Jacob B. Whitemand, of Wayland, to work quarries and to manufacture Portland cement. Capital stock, $100,000.

The Mason Contractors' Department.

Conducted in the Interests of the Builder and the Contractor for Brickwork.

CRACKS IN BRICKWORK AND PLASTERING.

WHAT CAUSES THEM, AND HOW THEY MAY BE PREVENTED.

BY A. H. DYER.

It is a noticeable fact that many brick buildings of moderate size and cost are planned and built in a manner that would indicate that the architects, as well as the builders thereof, place little or no significance in the fact that all cracks that occur in building construction have a well-defined cause, and can therefore be prevented if proper precaution is used, and that, too, without materially increasing the cost of the building. As before stated, they all come from well-defined causes; therefore, there is nothing mysterious about them; consequently they ought to receive practical, matter-of-fact treatment, entirely free from useless formulas or intricate mathematical problems, neither of which will be found necessary in any of the following examples, but it will require a thorough knowledge of materials and plain common sense, added to long-continued practise and close observance of results, to become what might properly be termed "an expert."

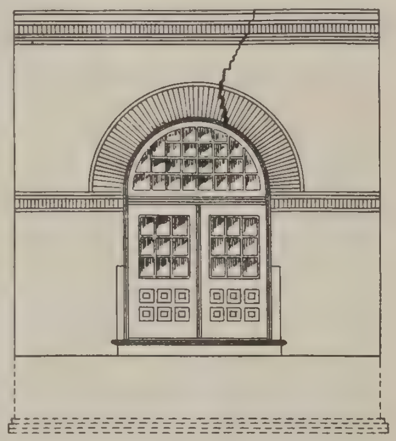


FIG. 1.

The author does not claim to have discovered anything new in the art of building, but believes that some of the most important things already known should be more fully understood and practised.

Take, for an example, the end wall of a small one-story warehouse, as shown in Fig. 1, and notice the irregular crack through and above the arch. Should we inquire the cause of this defect, it is safe to presume that the general answer would be, "Foundation not heavy enough." As no one seems to know the exact dimensions of the foundation, or why or where it is not of sufficient proportions, it will be necessary to dig down to the footings and also get the dimensions of the wall before we can make a practical investigation. The dimensions of the wall are found to be as shown in Fig. 2, the wall being 12 ins. thick, the bottom footings 20 ins. in width, and the soil beneath them to be a thick bed of coarse dry sand. The center girder is supported by an independent pier, and the ends of the floor and roof joists rest upon the side walls. Taking the height of the wall between one of the corners and the jamb of the opening, and figuring the brickwork at 112 lbs. per cubic foot, we find the weight of the 12 in. wall, including the offsets of the footings, to be 2,621 lbs. per lineal foot; therefore, the load at this point will be about 1,573 lbs. upon each square foot of bottom footings. As this kind of soil can be safely loaded with twice that amount per square foot, it would not in this case appear to be overloaded. Upon further examination, we find that the brickwork below the center of the opening gives a load of only 346½ lbs. per square foot, or less than one fourth the load between the opening and one of the corners. It is true the weight directly above the opening is equally distributed upon each jamb of the opening, but in a foundation of this depth and an opening of this area the load below the center of the opening will not be increased to any great extent by the weight above the opening. It is very evident that in case of any settlement of the foundation that portion under the center of the opening would not settle to as great an extent as would the foundation at each side of the opening, which has more than four times as much load per square foot. This would cause the soil below to be compressed to a convex plane, or, in other words, the quoins or corners of the building would be thrust outward at the top and away from the opening, and the continued strain would cause a crack similar to that shown in Fig. 1, always beginning at the nearest weak point of brickwork on the side most affected by the unequal settlement, or on both sides simultaneously, as the case may be. In a semicircular arch this weak point would naturally be where the joints begin to assume a nearly perpendicular line. The brickwork being bonded together, the entire width of the building above the arch prevents the crack starting at the top of the wall, which would undoubtedly be the case if there were no opening, provided that the foundation settled to the same extent and in the same manner.

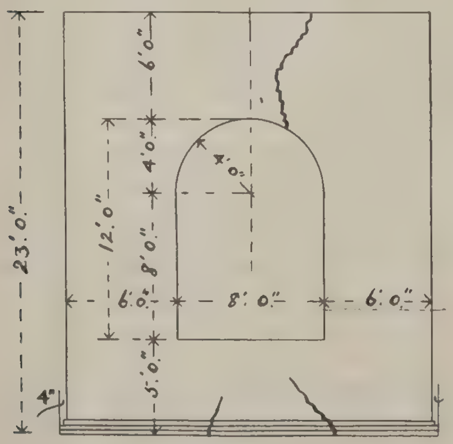


FIG. 2.

Having proven without a doubt that the crack was not caused by an overloaded foundation, also that it could not be caused by a uniform settlement, we must therefore admit that it was caused by unequal settlement. As it would be impracticable as well as quite expensive to attempt to insure a brick building against any settlement whatever, we must devise some method by which the settlement, if any, shall be equal and uniform throughout the entire area of the footings. This is somewhat difficult to accomplish where the soil is not uniform, but in this case we have a uniform bed of coarse, dry sand.

Some authorities have claimed that the only way to insure an equal settlement of a foundation was to build an inverted arch below each opening, or tier of openings, and that the inverted arch should be either semicircular or parabolic.

While it may be admitted that an inverted arch may prove beneficial in some cases, it must be remembered that a great deal of harm may come from them if used promiscuously, and under no conditions whatever should they be used near the quoins of a building, as the result may be still more disastrous than that caused by a continuous footing without them.

In the case of Fig. 3 there is one important reason why the inverted arch will not give the desired result; the width of footings under the arch and below the opening is the same as between the opening and the corners of the building; or, in other words, we have a continuous footing of uniform width the same as shown in Fig. 1.

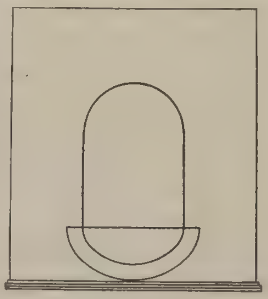


FIG. 3.

The inverted arch does not lessen the load at the corners; neither does it create and distribute a load of five tons below the opening to compensate the weight of five tons of brickwork which has actually been removed from the center of the wall. If the wall were solid, or without any openings whatever above the footings, and of a uniform thickness and height, each square foot of footings would support a uniform weight; but if we remove a weight of five tons from the center of the wall, as in Fig. 3, and do not diminish the area of footings accordingly, the load per square foot cannot by any means be equally divided.

The inverted arch does not weigh any more per cubic foot than the other brickwork, and, although it may have a tendency to distribute the weight farther toward the center line, it cannot in the case of Fig. 3 place a weight of 1,573 lbs. upon each and every square foot of footings below the opening, *because it lacks just five tons of being heavy enough.*

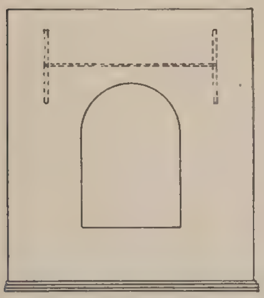


FIG. 4.

Fig. 4 shows another method of treating an opening like that shown in Fig. 1. The writer has known of several instances where a ⅞ or 1 in. iron rod, and I beam anchors from 6 to 8 ft. long, were designed and specified to be built into the wall just above the opening, and as shown in Fig. 4. This might perhaps prevent a total collapse of the wall, or it might cause the crack to appear at the outside line of the anchors instead of in the arch, but we fail to see how it in any way affects the footings. It would be almost impossible to build these anchors and the rod in the center of a 12 in. wall and have the rod of sufficient tension to prevent a crack in case of unequal settlement, like Fig. 1; and, besides, it would be necessary to cut out the center of the wall to such an extent as to weaken the bond of the brickwork just where the most strength would be required. This method is as impracticable as it is useless. With the 6 ft. of brickwork at each side of the opening, the semicircular arch and the brickwork above, it is amply able to care for itself if built upon a perfect foundation. The anchors and tie are in this case a bungling attempt to hide the effect, without removing or modifying the cause. There are cases where a tie-rod would serve to prevent "buckling," but this is not one of them. A cotton string, with a lath nail tied to each end and laid in the joints, would be much better so far as removing the cause of cracks is concerned, for it would not weaken the brickwork.

Fig. 5 shows another method which is more practical than either Fig. 3 or Fig. 4, and is sometimes used in shallow foundations with very good results, but it is not always to be relied upon.

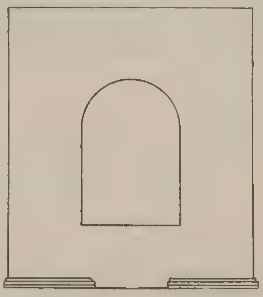


FIG. 5.

Fig. 6 shows a practical way of proportioning the foundation of a wall, as shown in Fig. 1 and Fig. 2.

The wall is divided into three sections or panels, A, B, C.

We will place the width of the footings at 20 ins., the thickness of the wall above the footings at 12 ins., and the weight per cubic foot at 112 lbs. A weighs 15,736 lbs., which gives a load of about 1,573 lbs. per square foot. C is the same as A; a weight of 9,986 lbs., or, approximately, five tons have been removed from panel B. In order to have a perfect foundation, we must reduce the area of footings in B, so that the load per square foot will be approximately the same as in A and C, and in no case should it be less, but in Fig. 1 it is less than one fourth as much. By adding together the weights of the different sections in B, as marked on the elevation (in cubic feet), we find that it will be necessary to "cut out" 4 lin. ft., or 6⅔ sq. ft. of the footings below the center of the opening. In order to support the brickwork above the "cut out," we will turn a segment arch, as shown in the bottom section of Fig. 6. The opening below this arch takes out approximately 4 cu. ft., which we will deduct from 43⅓ cu. ft., as shown above, for in this case we are making no allowance whatever for any weights above, except the brickwork, in order that we may more thoroughly demonstrate the principle of a uniform footing, and, moreover, the extra weight of frame, doors, and transom upon B would be desirable, as this panel should be loaded a very little heavier than the outside ones, so that the compression of the ground beneath would have a tendency to be *very slightly* concave, instead of convex. Upon further examination we find that the footings inside of the jamb lines and upon each side of the "cut out" cover an area of 3⅓ sq. ft., or a total of 6⅔ sq. ft., more than is required to support A or C.

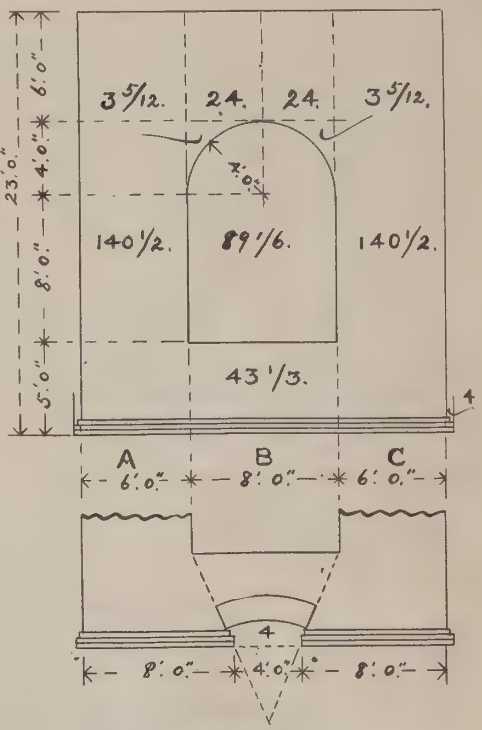


FIG. 6.

Taking out the contents of the opening and "cut out," we have a total weight in B of 94⅙ cu. ft., or 10,546 lbs., divided by 6⅔ sq. ft. of footings would be approximately 1,581 lbs. per square foot, or 8 lbs. more per square foot than the load upon A or C, the difference of 8 lbs. being on the safe side, as recommended above. Now, to prove that we have made no errors, we will divide the net weight of the entire wall, which is 375⅙ cu. ft., or 42,018 lbs., by the net area of footings, which is 26⅔ sq. ft., and we have an average load of about 1,575 lbs. per square foot, or 2 lbs. per square foot more than the actual load of A and C, or a total excess of about 52 lbs. The extra load of 8 lbs. per foot in B, for the 6⅔ sq. ft., would also amount to 52 lbs., which proves that we have made no serious error in our calculations.

It will be noticed that in figuring the area of footings we did not take into account the 4 in. projection at each end; by Fig. 7 it will be seen that by separating the side wall (with its proper share of footings) from the end wall, and removing A to B, the end wall will have its proper share of footings and no more; this fact should also be remembered when calculating the area of footings. We have now fully demonstrated the fact that the crack, as shown in Fig. 1, was not caused by an insufficient area of footings. We have entirely removed exactly one fifth of the original footing and now have a foundation that has practically a uniform load for each square foot of footings, and furthermore we have in this case a foundation that is sufficient to support twice the amount of weight, provided all other footings of the building are proportioned in a like manner. If *a hole* 10 ft. sq. in a 12 in. brick wall weighs *as much as 100 cu. ft. of brickwork it will need just as much footing below it as if the wall were solid; if it does not weigh as much as the solid wall it does not require as much footing.*

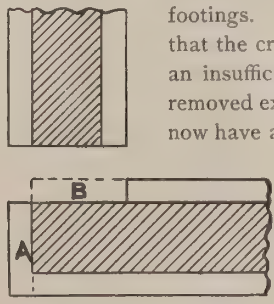


FIG. 7.

If it is necessary to close up the opening under the segment arch, an 8 in. or, in most cases, even a 4-in. wall may be built in the opening, but the center of same should conform with the center of the main wall, and should have no footings whatever, and filling in should not be done until walls are completed and have had time to settle, and should be done in a manner not to interfere with the settling of the main wall.

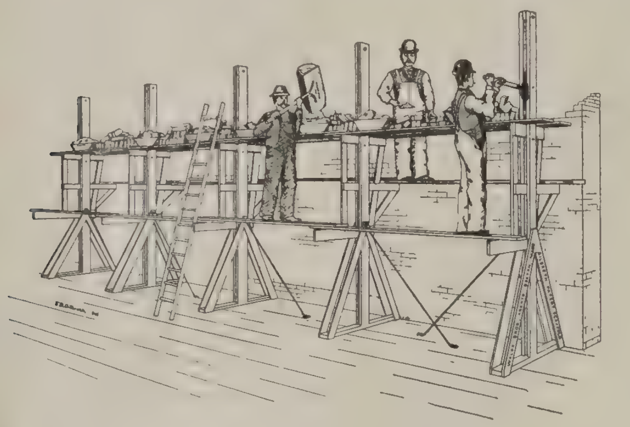
ONE of the most important advances in contractors' machinery that has come to our notice is an inside scaffold from which to lay brick, lately put upon the market by a Boston mason, named Gilbreth.

Nearly every contractor has had his experience with patent scaffolds, and has, after using them a short time, discarded them for the old trestle horses. This scaffold, on the contrary, seems to have come to stay, as those who are using it agree with the inventor that it actually saves from 25 to 40 per cent. in labor in laying brick.

The scaffold itself consists of a horse which supports a sliding frame, which in turn carries platforms at three different levels, — *i. e.*, on the top rest the planks for the brick and mortar; on the side toward the wall the masons' planks are located a distance down below the stock platform that enables the mason to pick up materials with the least effort and without stooping; on the side away from the wall the tenders' platform is located at a distance below the stock platform that they may deposit the stock without climbing any higher than is absolutely necessary.

This arrangement of the platforms enables the workmen to do with the same effort nearly twice the amount of work that they could on the old-fashioned scaffolds.

A simple and ingenious pulling jack has been devised to lift the platforms,— supporting frames and stock without stopping the workmen. This jack consists of only four pieces, — a case, a rack-bar, the lower end of which is hook shaped, a ratchet handle, and a gravity pawl.



In order to lift the scaffold, the jack is hooked onto a pin which is passed through the uprights of the horse. The lower end of the rack-bar hooks into the hanger of the frame. A few strokes of the handle raises the frame eight inches, and it is supported by a pin which passes through a hole under the top member of the frame.

One jack only is required for a large number of horses, as it is light and easily carried from one horse to another.

This scaffold is especially adapted to walls built "overhand," as the mason can back up the wall the full width as fast as the wall is built. This is particularly desirable in frosty and wet weather; and every mason knows that bricks can be laid faster in this manner than when the further or overhand side of the wall is built up thin, staging high, and is then backed up. The demand on the tenders for stock is more uniform, which is also an advantage.

The success this staging has met is due, in part, to its extreme simplicity. It takes no longer to set it up than to set up any other, and when once in place the wall can be built without interruption or delay the whole height necessary for the next floor beams, which is very desirable where rapidity of construction is required.

When the horses are not in use they take up very little room, — in fact, less room than trestle horses.

One of the most important features of this scaffold is that it is all in one piece, and any unskilled laborer can set it up after having once seen it in operation. No staging lumber is wasted.

At the last exhibition of the Massachusetts Mechanic Association this scaffold was awarded a silver medal.

Recent Brick and Terra-Cotta Work in American Cities.

A Department Devoted to the Interests of the Manufacturer.

CHICAGO. While Chicago real estate transactions have been very slow lately, the volume of building operations for July has been good,— nearly doubling the record for July, 1894, and surpassing any month since the World's Fair activity.

"A friend of mine rented a small, six-room, steam-heated flat on the South Side the other day, for thirteen dollars per month." Remarks of a similar kind are frequently heard, showing that rents are considerably depressed. But, notwithstanding the commonly talked of over-supply, the building of apartments goes on at an astonishing rate. Much of it is due to improved transportation facilities, the new electric and elevated roads having made available much new territory. Many cheap buildings are being erected in the outlying districts. A good part of the present building activity, however, is in the line of nice residences for wealthy and well-to-do people.

Pile foundations are now going in for two more large buildings, — one, the new Studebaker office and warehouse building on Wabash Avenue, S. S. Beaman, architect; the other, the eighteen-story Fischer Building, D. H. Burnham & Co., architects. No wood enters into the construction of these foundations except the piles themselves. A heavy layer of concrete covers the heads of the piles, and this in turn supports two tiers of steel beams filled solid with concrete. The cast stools are then bedded on cement mortar, the bed varying from ½ in. to nearly 2 ins. in thickness under different stools. The chief difficulty in using piles in Chicago has been the almost disastrous results to adjoining buildings from the driving. In the above-mentioned instances the adjoining buildings are small and easily taken care of.

Another new office building will begin construction soon on Dearborn, south from Van Buren Street. It is 50 by 60 ft. in plan, and twelve stories high, but, like the Atwood, it will be built for the addition of three more stories as soon as the 130 ft. limit ordinance is repealed. The front of this building will be buff brick, white joints, with trimmings of white glazed terra-cotta. Jenney & Mundie are the architects.

Ground has been broken for the temporary post-office, and now the question (likely to be answered before this goes to press) is, "Who will be the architect for the new permanent government building?" As usual, those working hardest for the appointment are least worthy, and it would not be surprising if politics should rule and another boodle building scandal be added to the list.

A certain large apartment building in Chicago, destined by its owner to be the finest of its kind, has had serious troubles in the way of defective foundations, which settled disastrously and threatened to throw out the front. Lately, while the building was still unfinished, the owner met a tragic death by falling from the roof.

One of the most sensational items of news among architects lately has been the retirement of Mr. Dankmar Adler, who leaves the practise of his profession to take charge of the sales department of an elevator company. The news came in the way of a shock. It is safe, perhaps, on general principles, to predict that a successful veteran like Mr. Adler will not stay out of architectural harness very long.

The death of Richard M. Hunt has brought eulogies from all directions. Chicago has had a special claim on Mr. Hunt since the World's Fair, and feels a personal loss in his death. So strong were his personal qualities that architects who had not even met him feel now as if a friendship were broken.

DETROIT. Business in building circles has shown a decided improvement the past week over any similar period in a long time, and builders are greatly encouraged.

Among the sales are a number of lots in the better portions of the city, upon which new buildings are to be erected forthwith. The same encouraging state of affairs extends to the architects, nearly all of whom are busy on work that is to be done at the earliest possible period.

Indeed, the situation is such that the actual demands of the growing city are forcing business both with the architects and real estate men. The idea is firmly established that prices have reached their lowest point and that buildings will never again be erected for the figures now taken upon them. Two magnificent new buildings are announced for erection this week, and the prospect is that the coming month will be the best for building this year.

Traugatt Schmidt will immediately begin the erection of a substantial business block on the site of the one recently occupied by Keenan & Jahn, which was destroyed by fire. The matter has only been delayed thus far for lack of a suitable tenant. The other day a fifteen years' lease of the new building was signed by L. N. Valpey; and Donaldson & Meir, the architects, have been directed to proceed with the execution of the plans in compliance with Mr. Valpey's suggestions with all possible despatch. The new structure will be 60 ft. by 100 ft. and eight stories in height, costing about $60,000.

Another architectural ornament is soon to be added to the many handsome buildings of Detroit. August C. McGraw has had plans drawn and will soon begin the erection of a magnificent apartment house on the north side of Jefferson Avenue, to cost $70,000. The plans are by Spier & Rohns, and contain the result of wide research on the part of Mr. McGraw, whose purpose is to make the apartments superior to anything of the kind in Detroit. The building will be 54 ft. by 88 ft., six stories in height, and constructed of pressed brick with terra-cotta trimmings.

The design submitted by Architects Mason & Rice was adopted by the commissioners of the fire department and will be used for three new engine houses, costing $20,000 each.

The same architects have prepared plans for a brick stable for the Park, to cost $35,000. The Park and Boulevard commissioners have been considering the plans and perfecting the specifications during the past week and on Friday next will receive proposals for its erection.

A Detroit architect has completed plans for a brick store building to be erected on the triangular corner of Congress Street, Cadillac Square, and Randolph Street, for Dr. S. G. Miner. Building will have 100 ft. frontage, and will be built of pressed buff brick, five stories high, costing $100,000.

Architect Joseph E. Mills has prepared plans which have been duly adopted for a new brick church edifice for St. Johns German Evangelical Lutheran Society. The work of construction will be commenced at once.

The subscribers to the fund for the Woman's Building have decided not to wait until the entire amount of $60,000 is raised, but to go ahead with what they have, on the plan of the Chamber of Commerce. They are now figuring on a site for the building.

ROCHESTER building, though comparatively quiet this year, seems to be slowly increasing. Messrs. Fay & Dryer are having plans figured for a three-story store building to be built for Sleight & Brownell, on Lyell Avenue (New York Hydraulic-Press Brick); cost about $8,000.

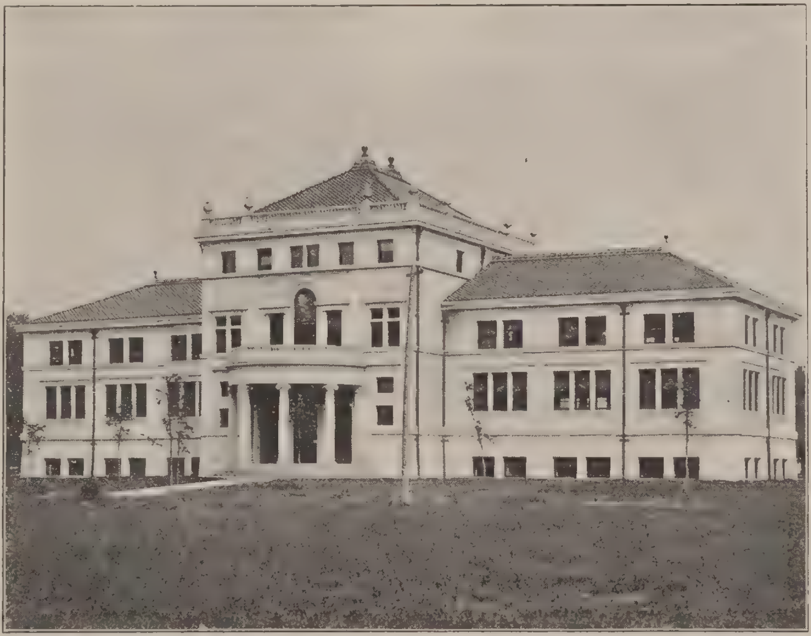
Geo. F. Hutchison has just let contract to John C. Geminder for the erection of a new district school at Irondequoit, N. Y., for $7,000.

Mr. J. G. Cutler, the well-known manufacturer of the mail chute, is erecting an office building on the corner of East Main Street and Belmont Park, which for the present will be two stories high, but when complete will be six stories, and will run through to East Avenue; New York Hydraulic-Press Brick Company's old gold brick.

Kelly & Headley have let contracts for the erection of a Roman Catholic Church at Clifton Springs, N. Y. It will be built of New York Hydraulic-Press Brick and cost $15,000.

Messrs. Walker & Briggs have plans ready for figuring for additions and alterations to Western New York Institute for Deaf Mutes, cost about $10,000; and Armory Building for the Second Division Naval Reserve at Charlotte, N. Y.

Chas. F. Crandall has just let contract to Henry Oberlies for the erection of additions to the almshouse for $6,625.



ORRINGTON LUNT LIBRARY, NORTHWESTERN UNIVERSITY, EVANSTON, ILL.
W. A. OTIS, Architect, Chicago.

ORRINGTON LUNT LIBRARY.

THIS building was given to the Northwestern University by Mr. Orrington Lunt, of Chicago. The architect is W. A. Otis, of Chicago, who has a well-established reputation, not only as a practitioner, but also as a lecturer in his profession in several educational institutions in the West, and is an advocate, not only of good designing but of the use of first-class materials in a field where as yet price too often cuts the greatest figure, and worth and adaptability are regarded as of secondary importance to cost.

This building shows a design in the best style of colonial work. The walls are of dressed Ohio sandstone and the roof and roof trimmings of tile and terra-cotta from the works of the Celadon Terra-Cotta Company, Charles T. Harris, lessee, at Alfred, N. Y. The tile are of red color and are laid in alternate sizes of 4 in. and 8 in. “Conosera” design, which gives to a low roof a lighter and livelier effect than the 8 in. by 12 in. tile alone would in mass. The finial and ridge give a finish and completeness to the whole roof that is very satisfactory. The same combination of tiles was used by Architect S. S. Beaman on the Pullman Memorial Church at Albion, N. Y., last season, with a result that has been highly commended by all who have seen it. For higher roofs and larger buildings the larger tile in mass is to be preferred. The Celadon Company are now making this shape of tile in sizes of 10 by 15 ins., 8 by 12 ins., 6 by 12 ins., 4 by 12 ins., 3 by 12 ins., and 2 by 12 ins. With these combinations, not only can any possible tower or curved surface be perfectly fitted, but light and shadow effects can be obtained possibly with no other tile made.

BUFFALO. — The activity in building has not increased during the past month, outside of those at present erecting and a few school competitions.

The real estate outlook is brighter. Plenty of money can be had upon A 1 investments.

Depew, our suburb, received quite a boom lately, but now seems to be going more conservatively.

The high school competition has been decided in favor of Beebe & Sons. Cost, $175,000.

The large buildings are now assuming shape. The Guarantee Building has reached its fourteen stories, with terra-cotta up six stories. The architects are Adler & Sullivan, Chicago. The terra-cotta was furnished by Northwestern Terra-Cotta Company.

The Endicott Square Building will be ten stories high, and occupy one whole block, while sides will be 203 ft. and 240 ft. respectively. Burnham & Company are the architects. Cost, $2,500,000. The brick and terra-cotta will be furnished by the Perth-Amboy Terra-Cotta Company. Otis elevators.

Realty Building has its foundations set. It will be ten stories, iron construction. Green & Wicks are the architects. Cost, $250,000.

The following is a mention of some of the more important work now being done: —

The Moody-Brisbain Building, eight stories. Beebe & Sons architects; Sayre & Fisher brick.

W. O. Chapin Building, E. A. Kent architect, four stories high, cream brick; terra-cotta furnished by New York Architectural Terra-Cotta Company.

Rumsey Building, George Cary architect. Cost, $50,000. The terra-cotta was furnished by the Northwestern Terra-Cotta Company. It is white, glazed, and gives people the impression of white marble; quite striking.

La Salle Flats, F. H. Loverin architect. Cost, $75,000.

The Laird Flats, Strong & Wilby architects; 100 by 100 ft.; absolutely fire-proof. Cost, $200,000.

The Carmichael Flats, George J. Metzger architect. Eighteen suites of rooms. Cost, $75,000. Sayre & Fisher brick.

WITH the coming of high buildings has arisen an imperative demand for better elevator facilities, and the manufacturer of elevator machinery has been called upon to exert himself to keep pace with this demand. It would now seem that the electric elevator is in a fair way to become a very formidable rival to the belt, steam, or hydraulic lifts.

Mr. Wyman, of the Moore & Wyman Machine Works, South Boston, states that they have an ever-increasing demand for the electric elevators, both to replace old style machines taken out, as well as for new buildings, and that the electric elevator is constantly growing in popularity from the many advantages peculiarly its own, among them being its ease in manipulation, its automatic safety arrangement, its minimum cost in operation, and its obtainment of a perfectly smooth movement of the car.

THE "Conosera" tile made by the Celadon Company has been specified by Architect Angus S. Wade for the roof of the new Walton Hotel, Philadelphia.

ARCHITECT DUBOIS CARPENTER has opened an office at 242 Church Street, Poughkeepsie, N. Y., where he would be pleased to receive catalogues and samples.

THE ATWOOD FAIENCE COMPANY, of Hartford, Conn., have opened an office in the Institute of Building Arts, Chicago. Mr. Burton Hills has been appointed general manager.

HERE IS ONE

Representation of a FIREPLACE MANTEL. Our Sketch Book, containing 39 others, will be sent you on application.

JUST

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FIREPLACE MANTELS

MADE OF MOULDED BRICK

In such Colors as Red, Cream, Buff, Pink, Brown, and Gray. These Mantels cost no more than other kinds, but are far better. They are easily set, and have a richness and simplicity of effect which is decidedly pleasing.

PHILA. & BOSTON FACE BRICK CO.,

No. 4 LIBERTY SQUARE, BOSTON, MASS.

VOLVME
IIII
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1895
NO·9

THE
BRICKBVILDER

OFFICE
85
WATER
STREET
BOSTON

THE BRICKBUILDER.

AN ILLUSTRATED MONTHLY DEVOTED TO THE ADVANCEMENT OF ARCHITECTURE IN MATERIALS OF CLAY.

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THE IRELAND DISASTER.

FROM the mass of details that the daily newspapers have given us, in connection with the fall of the Ireland Building in New York, one truth stands out conspicuous,— the inefficacy of law to procure safe buildings.

Not the least interesting fact in our present half-baked age, to the members of a future and higher civilization, looking back upon the development of the intellect at the close of the nineteenth century, will be our fond trust in legal enactments to obtain our desires, regardless of the physical and logical possibilities of the case.

Philosophers have preached, with the applause of the galleries, but with the comprehension of only a few in the audience, the function and scope of government, pointing out that the greatest possible liberty of action for the individual was the condition of social progress and ultimate perfection, and that the only possible function of government consistent with further development of mankind was to maintain this condition of greatest possible liberty for all.

Quite recently the New York *World* devoted a whole issue to the defense of liberty, quoting Herbert Spencer, John Stuart Mill, Buckle, and the rest of the thinkers upon that topic, to support its demands, and very proper demands, for the removal of legal restrictions upon the liquor traffic, but without indication of any comprehension that the same principle applied to all departments of human activity.

Now, if this office of defense against aggression be admitted as the only office of government, the only case where governmental agencies could properly interfere with buildings at all would be where somebody had erected a building with the intention of causing it to fall upon others or had deliberately destroyed a building in order to injure the inhabitants. Even manifest insecurity is not aggressive, as long as others are not compelled to risk their lives in or near the dangerous building, and damage to the property of others, in case of a fall, is made good.

These conditions, however, do not occur. People do not build with any desire that their buildings shall fall, nor, except in war, which is a temporary relapse into savage conditions, do they destroy buildings maliciously. Everybody who builds is extremely anxious that his building shall be entirely secure, because it is very much to his interest that it shall be so.

As it is logically impossible for a liberty-defending government to restrict or revenge any but malicious damage done by builders, it is also physically impossible for a paternal government like ours to force its members into attending to their own interests better than they could attend to them unrestricted.

For consider what this matter of governmental supervision means.

It means that each architect shall have an angel guardian in brass buttons at his elbow to tell him just how to make every detail of his design. The present number of inspectors is totally inadequate to do this.

Architects will average at least two or three jobs at the same time. Work upon these while they are in progress goes on continually. General drawings, which now have to pass the Building Department, are followed by larger drawings of all parts in detail; framing plans, flue drawings, sidewalk vault drawings (which, by the way, are outside of the scope of the Building Department now, yet are, perhaps, more strongly built than any other part of the building), steam-boiler arrangements, drawings for elevators, schemes for high pressure electric work, and so on, a mountain of expert detail which cannot be minutely criticized by any one man, over which one man can exercise only general control, which must be handled by a system of hierarchical subordination and responsibility.

Then, when it comes to the supervision of the work in execution, it is equally impossible for an architect to know what goes on in particulars. If an architect has specified a proper thickness of concrete, for an instance, he has given his instructions, given them, moreover, in writing, and if the failure to comply with these instructions escapes his attention, the responsibility for results is upon him whose business it was to carry out the instructions. An architect is a guide and counselor, not a detective. Although it is his business to see that his design is properly carried out, he is not properly responsible for the failure of others to do as he tells them, and to do it in a good, sufficient, and workman-like way.

Although this sounds like heresy to those who flatter themselves that they can get a very cheap contractor, and that it is the business of the architect to make him do good work, it is backed by that most potent of arguments, — common sense. Everybody knows that it is impossible for an architect to spend all his time on a job; that visits, more or less frequent, are all that can be reasonably demanded. How is he to be responsible if his instructions, given during his visit, are disregarded the moment he has departed. Even if, as is often done on large buildings, he keeps a superintendent on the building all the time, how is the superintendent to be in all places at once? While he is hammering iron columns to detect flaws at one side of the building, a mason's gang at the other side may be bedding foundation stones with only a rim of mortar; while he is watching the completion of the roof, the cellar concrete may be going down half the thickness specified.

When we talk of governmental inspection securing perfection in details, we might as well remember that it would require not only an inspector apiece for each architect, but an inspector of each gang of workmen on every building in progress.

Better, while we are about it, abolish architects entirely and let the whole building business become a governmental bureau.

But reason is useless against that which is not founded upon reason. The superstitious confidence in law, which we still retain as part of our nature, is but a survival of the ancient spirit of subordination to monarchical control which will not breed out for some generations to come; we venture this expostulation to aid the process of breeding out, not in any hope of working perceptible change in the course of events.

Yet there may come a revulsion sooner than might be expected. People are beginning to object to the rapidly growing number of office-holders which is needed to carry out their continual demand for more laws and more complete enforcement of laws. They will gradually come to understand that laws cannot be carried out without office-holders to carry them out; that each revision and intensification of law requires the appointment of still more office-holders, reveals further defects, to remedy which there must be more laws, to carry out which there must be more office-holders, ending in a wholly Russian state of governmental control, and a total loss of inventiveness, initiative, and sense of responsibility in the people.

They will come to understand that without the false confidence begotten of supposed governmental control owners would not dare to employ incompetent architects, nor would architects dare to permit any but trustworthy contractors to be employed; that if we give to all, architects, owners, and contractors, full scope for their ingenuity in finding the best and cheapest ways of doing things and hold them responsible only for damage that may result, — the contractor responsible for properly carrying out the instructions of the architect, the architect for giving proper designs and instructions, the owner for employing competent agents, whether architects or contractors, — we shall at one blow secure safer buildings and check the growth of the office-holding class which already threatens our political institutions.

COMPETITION.

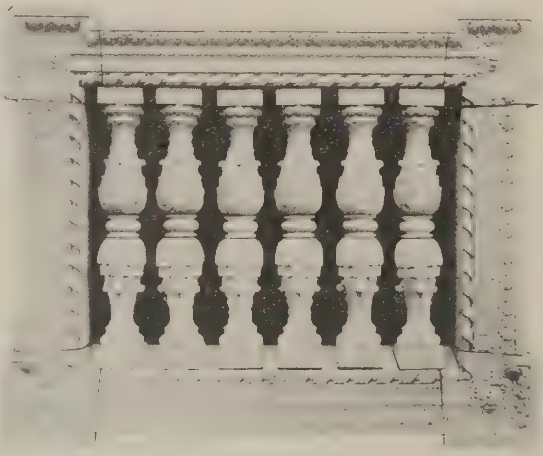
WE are authorized by the New York Architectural Terra-Cotta Company to announce a competition for the best design for a full-page advertisement to be used in The Brickbuilder. The drawings must be made in line with black ink on sheets cut to the uniform size of 14 by 18 ins. For the best designs there is offered a first prize of $50, a second prize of $25, a third prize of $15, and a fourth prize of $10. The prizes will be awarded by a jury of three architects of acknowledged reputation. Each drawing must be marked with a motto or cipher, and a sealed envelope similarly marked containing the full name and address of the designer must accompany the drawing. These envelopes will not be opened until after the award is made. The designs for which prizes are awarded will become the property of the New York Architectural Terra-Cotta Company. The Brickbuilder reserves the right to publish the successful designs. Other drawings, at the conclusion of the competition, will be returned to the competitors. Drawings must be delivered flat, express or postage prepaid, at the office of The Brickbuilder not later than October 1.

The program of the Wm. Connors competition for a design for an advertisement in The Brickbuilder may be found on page 201.

OUR ILLUSTRATED ADVERTISEMENTS.

THE church of S. Francesca Romana, Rome, is the subject of this month's illustration in the advertisement of the Hydraulic-Press Brick Company, which appears on page xix. The body of this church and the campanile belong to the ninth century. The façade shown in the illustration is a late Renaissance structure. As stated by the inscription over the door, the date of this façade is 1620.

On page xviii, in connection with the New York Architectural Terra-Cotta Company's advertisement, will be found an illustration of the façade of The Garrick (formerly Harrigan's) Theater, on 35th Street, near Sixth Avenue, New York City. Mr. F. H. Kimball is the architect of this very ornate and altogether successful combination of form and color in terra-cotta and brick. It is considered one of his happiest efforts, both in design and construction.



Many of the dramatic creations and characters associated with the former management have been enduringly depicted along the frieze and elsewhere blended with the more severely architectural detail, as will be seen by the adjoining plates.

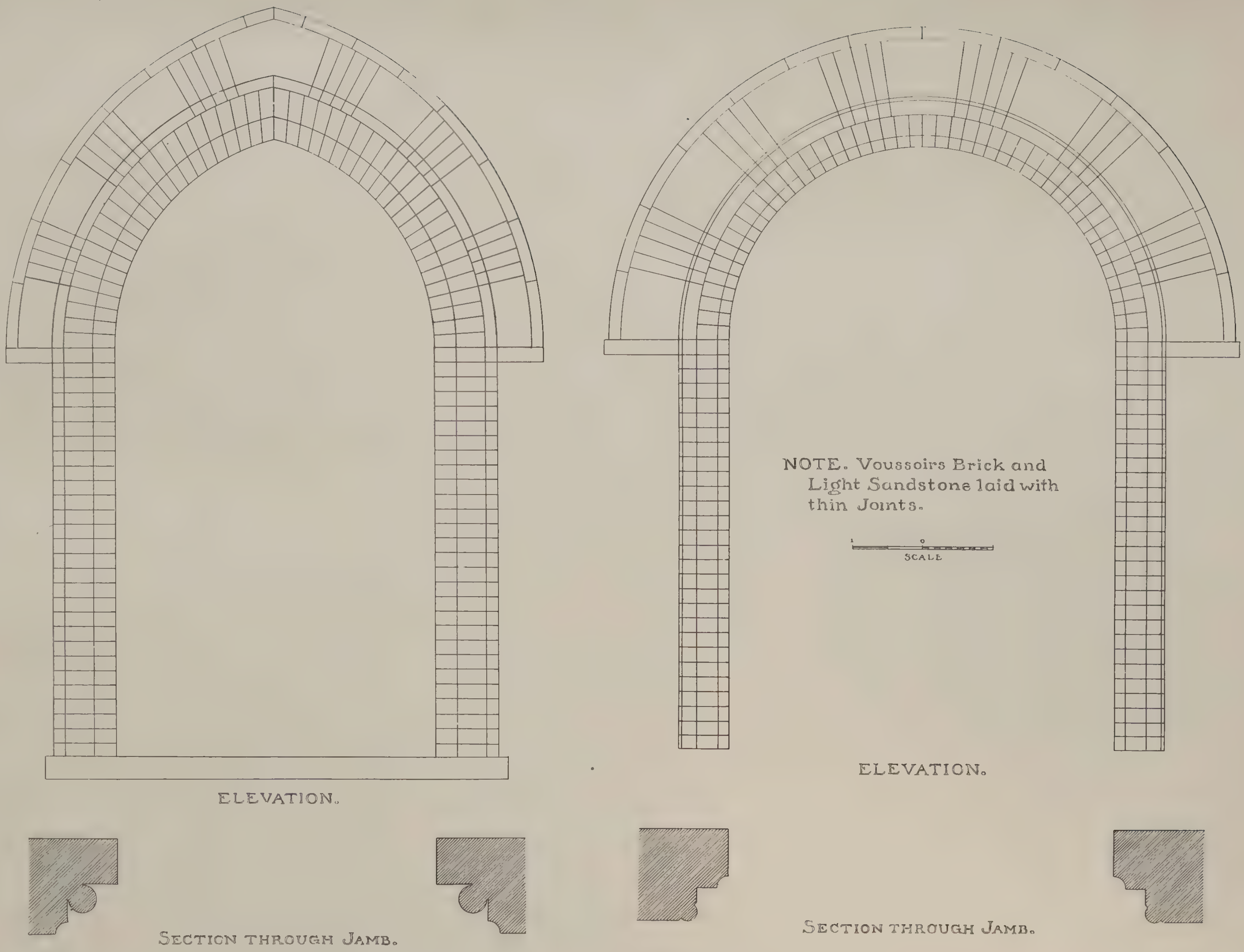
In the advertisement of the Eastern Hydraulic-Press Brick Company (see page xx) is illustrated the Syndicate Building, New York City.

The Atwood Faience Company (see page xvii) illustrate a mantel designed by J. A. Schweinfurth, and executed in faience.

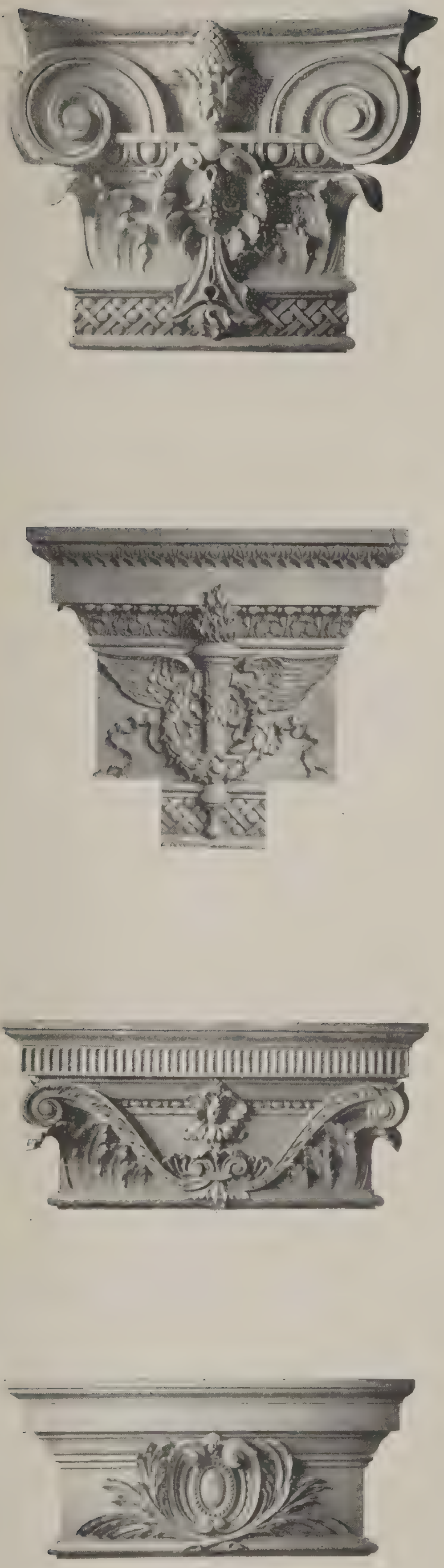
An interesting illustration is that which appears in the advertisement of The Celadon Terra-Cotta Company, Charles T. Harris, lessee (see page vi). The illustration is of twelve plates showing the same square of tile at different angles, also a variety of light and shadow effects.

ENAMELED BRICK OR CEMENT?

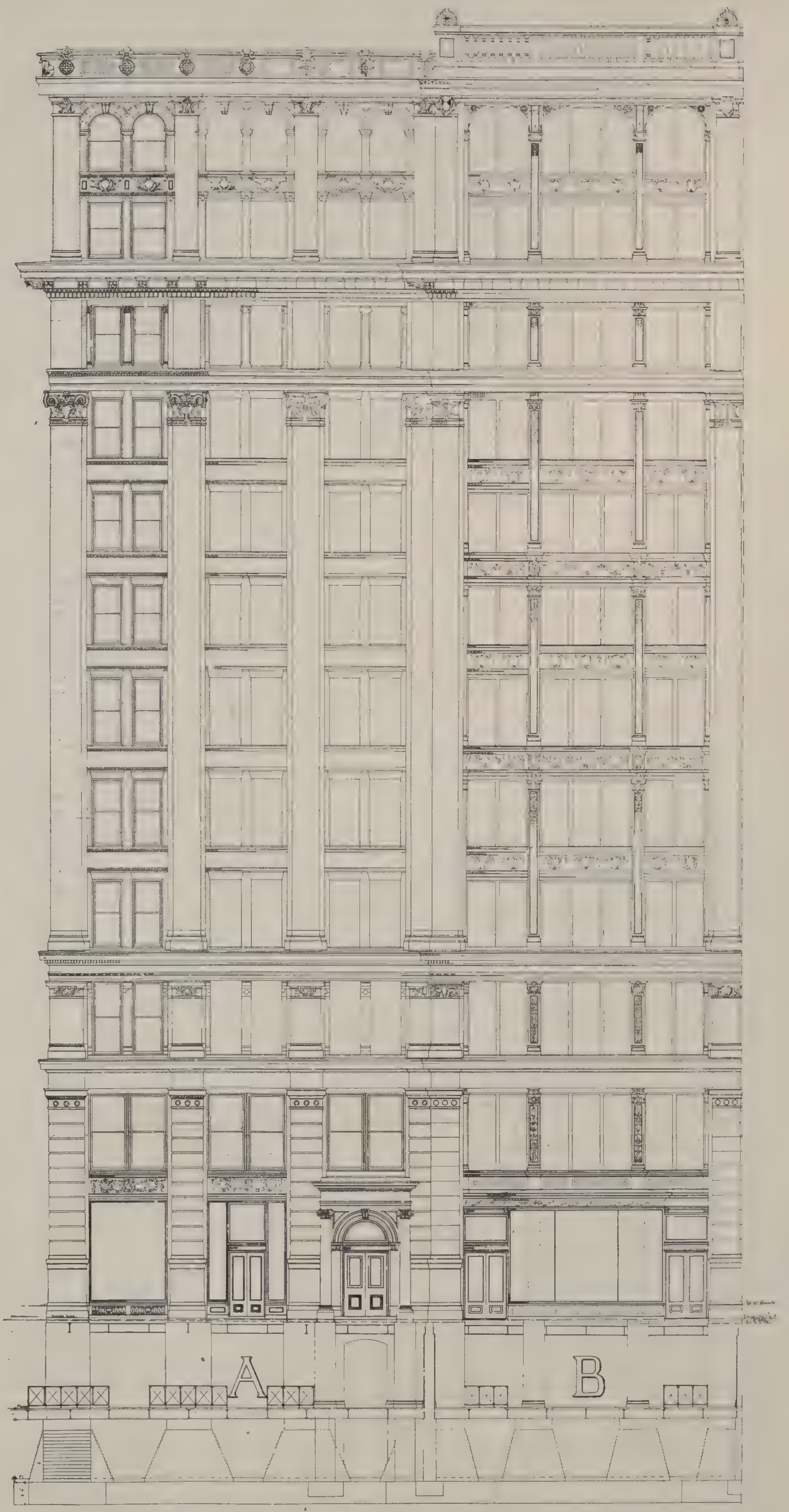
THE lack of economy can so seldom be described as a dangerous quality that when public officials undertake to save the pocketbooks of their constituents it is, as a rule, safer to praise than to blame; but at times and places economy may cease to be a virtue. Such a condition seems threatened in connection with the Boston subway. A prominent news item in the *Boston Herald*, a few days since, made the statement that the subway commissioners are seriously considering the use of cement or concrete in some form as a facing for the interior surface of the subway walls and presumably of the vault. There is a peculiar quality running through nearly all of our public work, which, for lack of a better name, is designated as



MEASURED DRAWING OF WINDOWS OF HOUSE ON VIA ARCHE ACALIGERE, VERONA.

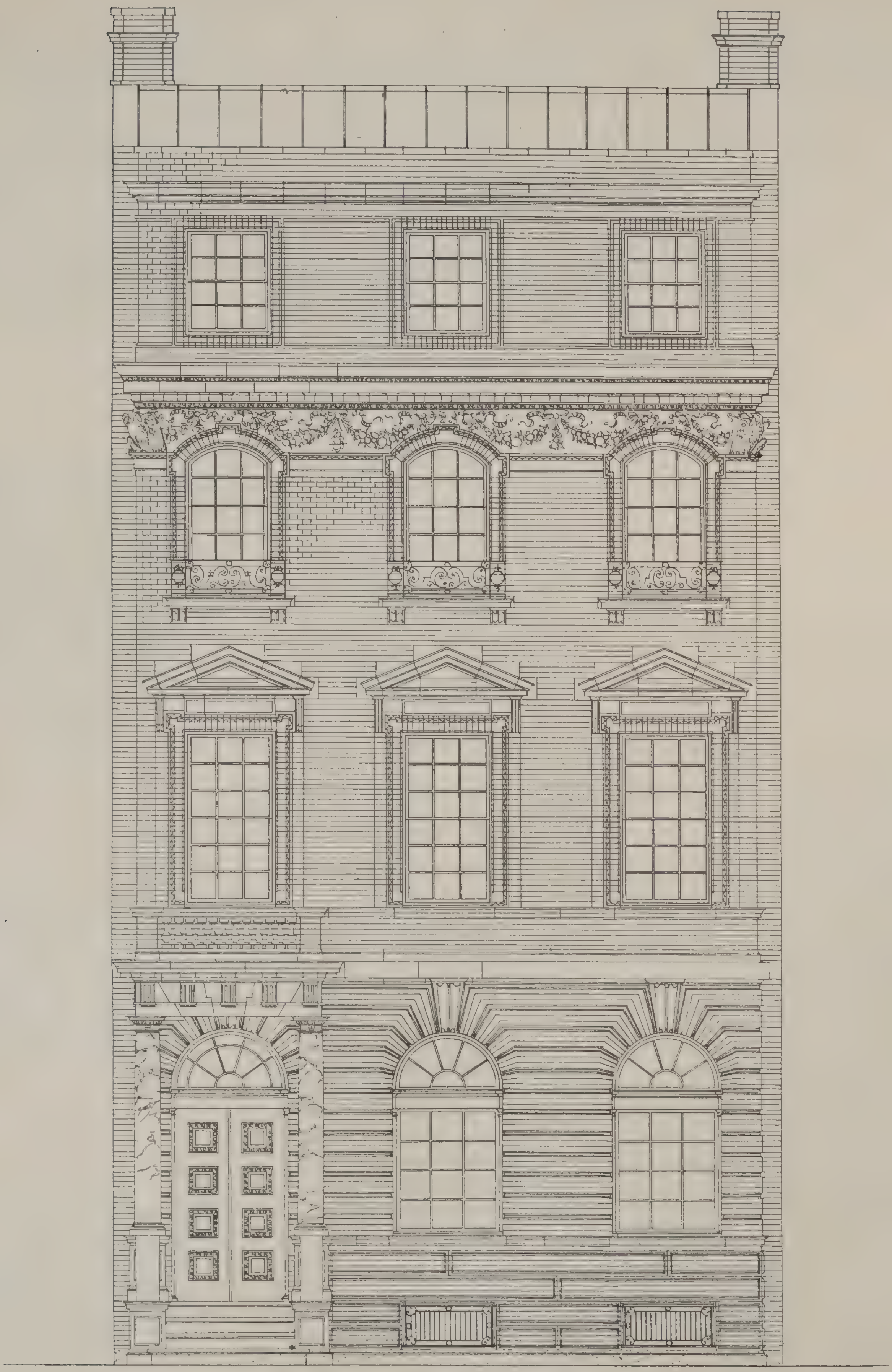


SERIES OF TERRA-COTTA CAPITALS USED IN THE NEW YORK BUILDINGS.



BROADWAY ELEVATION, NEW YORK BUILDINGS (SITE OF THE OLD NEW YORK HOTEL).

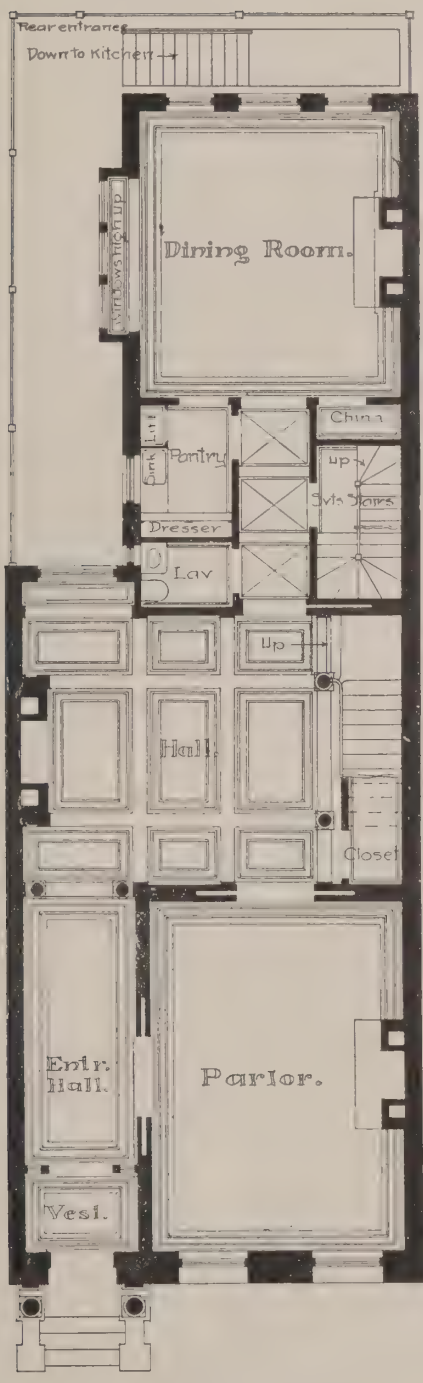
R. MAYNICKE, ARCHITECT.



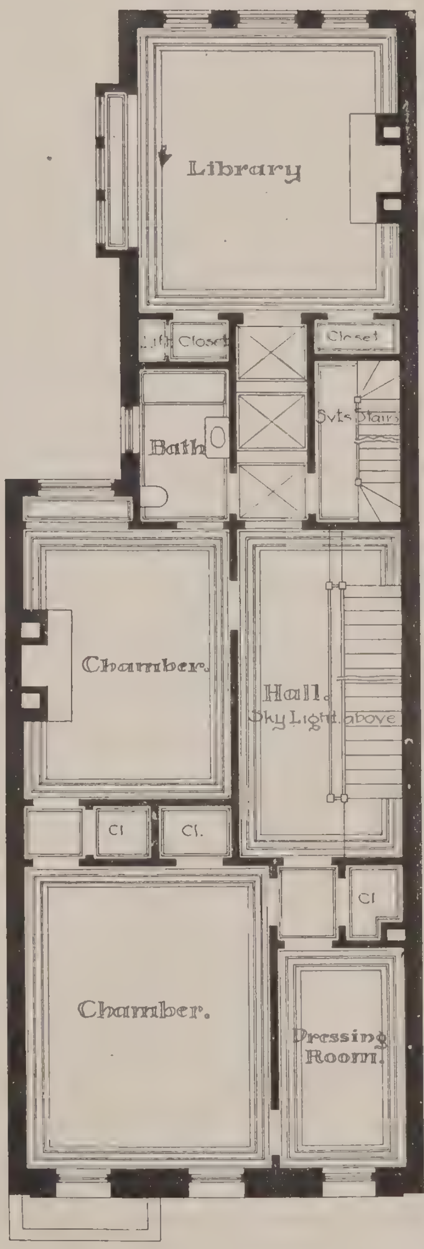
BRICKBUILDER COMPETITION FOR A CITY HOUSE. SECOND PRIZE.

EDWARD E. HENDRICKSON, PHILADELPHIA, PA.

"BRICK BUILDER" COMPETITION

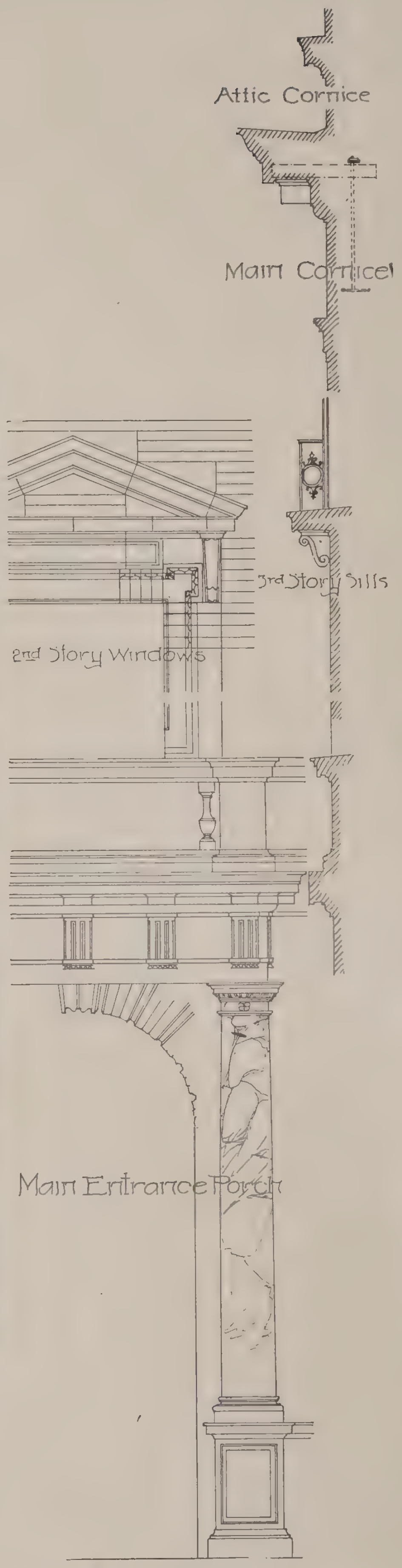


First Floor Plan.



Second Floor Plan.

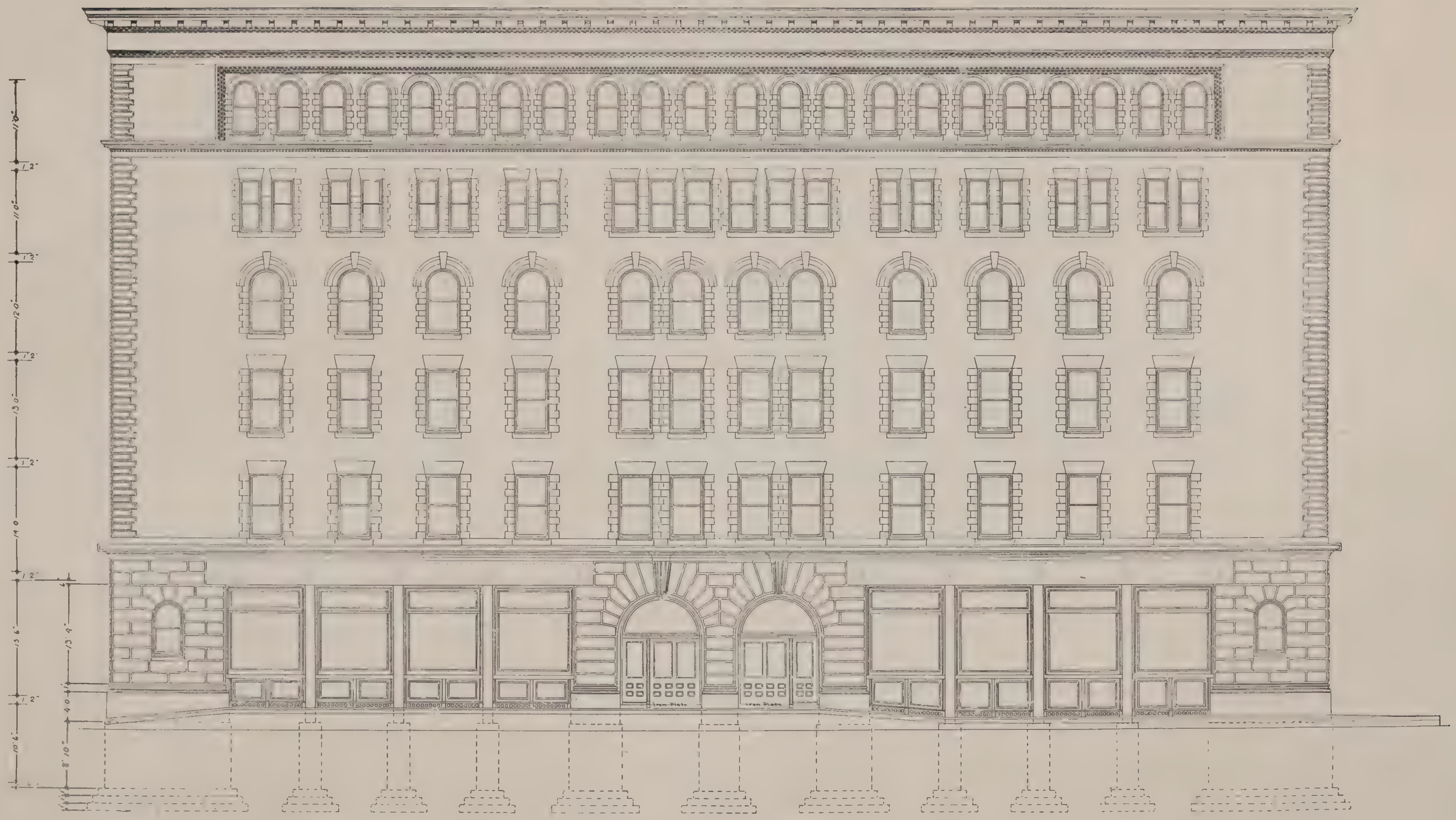
By "Wren"



Details of Front.

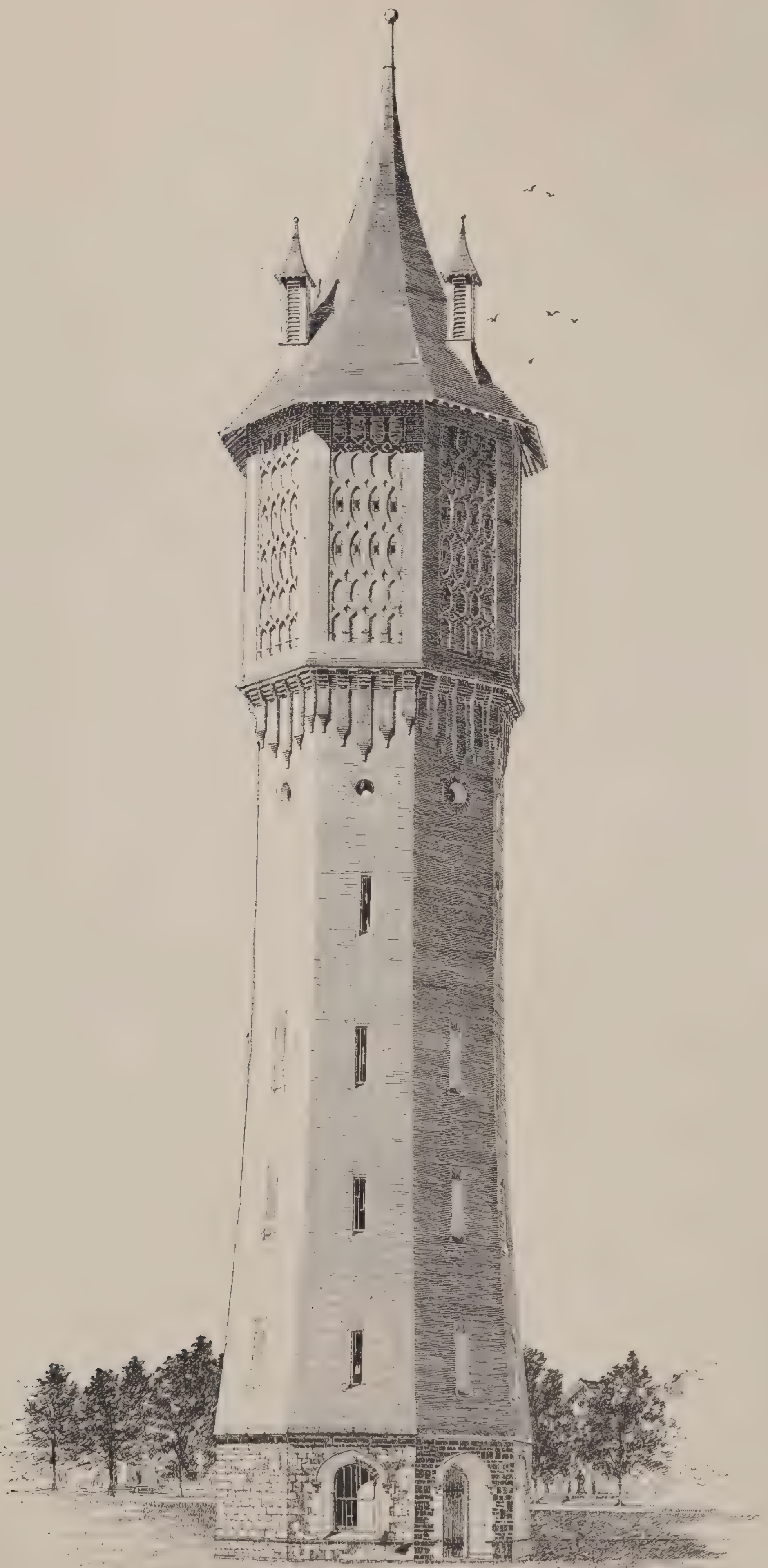
BRICKBUILDER COMPETITION FOR A CITY HOUSE. SECOND PRIZE.

EDWARD E. HENDRICKSON, PHILADELPHIA, PA.



HARRISON BLOCK, MINNEAPOLIS, MINN.

WARREN H. HAYES, 'ARCHITECT.



WATER TOWER, STATE HOSPITAL, TOLEDO, OHIO.
E. O. FALLIS, Architect.

New England thrift, and which is manifested by an intense desire for economy in first cost and a preference for what is merely "good enough," rather than for what is the best, so that when a public official feels upon his shoulders the burden of responsibility for a building, an aqueduct, or a subway, apparently the paramount consideration is to keep down the cost. Fortunately, we have in Boston an example of the opposite spirit in the case of our Public Library, which was first made right, and then the city was called upon to pay the bills. Now, we would not be understood as advocating in the faintest degree recklessness of expenditure; but, on the other hand, no public work should be marred in its completeness by mere consideration of cost, when a cheaper method or material implies a less satisfactory and complete piece of work; and in the case of the subway it is earnestly to be hoped that the commissioners will not consider anything like concrete or cement for a facing. The material which has been thought of all along in this connection is vitreous enamel in some form, presumably in the shape of glazed or enameled bricks, and it will be a cause of great regret if the commissioners consider that their duty is to make the subway simply inexpensive.

Cement as a facing material is so obviously inadequate that the objections must appeal to every candid thinker. Cement will stain badly under any conditions when exposed to weather, unless constantly protected by coats of paint or other surface treatment. It is about as bad a surface for collecting dirt as can be devised. In case of any break in its surface it is almost impossible to patch it without showing an ugly scar, and that breaks are almost sure to occur every one will acknowledge who has undertaken to face an underground wall with cement. The dampness is bound to work through from the back, and in time will peel off the coating, whether applied to brick or stone. In fact, the only advantage of concrete would be cheapness, an uncertain advantage in the long run, when we consider the annual charge for repairs and repainting; though the difference in first cost is quite considerable, glazed brick costing fully fifty cents per square foot, while cement need not exceed ten cents per square foot. But, on the other hand, enameled brick is thoroughly clean and is very easily kept so. It is practically indestructible; it cannot peel off, and it is an integral portion of the wall itself, and, consequently, stronger than any facing could be. Furthermore, it offers an opportunity for a very pleasing treatment of what might otherwise be a dark, gloomy vault. A great deal has been said in the past about the attractive appearance the subway is to present. An artistic effect is perfectly possible and can be obtained with comparative ease by the use of tiles or enameled brick, while it is simply out of the question with almost any other material.

Why can we not learn a little from what has been done elsewhere under similar conditions? In nearly all of the European capitals where it has been found expedient to build subways for the accommodation of the public enameled brick in some form has invariably been used and always with pleasing success, and it is a very poor argument in favor of cement that it is simply cheaper than the brick. The subway is not being built to save money, but to accommodate the people in the best possible manner consistent with reason, and even were the cost of enameled brick a great deal more it is so emphatically the material for the place that nothing else ought to be considered.

This may seem like an undue insistance upon an unofficial paragraph in a daily paper, but the subway is to be built for all time, and it would be neither advisable nor likely that enameled brick could be substituted at a later date, should the deliberation of the commissioners now result in the use of concrete. It is not an unimportant matter. Boston ought to take a pride in having a subway which is not only built reasonably, but built well and thoroughly, and with the best material at the command of the builder; and, though a newspaper reporter may find great charms in a "finish almost equaling in beauty the white enamel," a little consideration will make every practical reader appreciate that the bright, cheerful effect which has been promised can be obtained only by the use of enameled brick.—*Bostonian.*

BRICK AND MARBLE IN THE MIDDLE AGES.

G. Edmund Street.

CHAPTER VIII.—*Continued.*

FOR a building which owes its general impressiveness entirely to the uniform character of its architecture, it is especially fortunate that there should be so much also in the detail to attract and reward constant and minute examination. It is for this reason that the range of great capitals to the columns of the lower arcade is of so much importance. They are so large, so close to the eye, so interesting in their story, and on the whole so carefully and artistically executed as to afford the greater pleasure the more the building is known. The key-plan to these capitals which I give will be useful to show what the general arrangement of the subjects is.

APPENDIX.

CATALOGUE OF THE SUBJECTS OF THE SCULPTURED CAPITALS IN THE LOWER STAGE OF THE DOGE'S PALACE, VENICE.

THE capitals are numbered as in the accompanying key-plan, beginning at the south-east angle on the Molo front, and going from right to left until the last capital, near S. Mark's, is reached. For those who wish for something more than a catalogue, I need hardly say that in the latter portion of the second volume of the 'Stones of Venice,' Mr. Ruskin has given all that can be desired, with his usual felicity and beauty of verbal illustration.

In the 'Annales Archéologiques,' vol. xvii. (1857), Mr. Burges has given a very full and careful account of all the capitals, to which M. Didron Ainé has added some supplementary notes.

Zanotto ('Il Palazzo Ducale di Venezia,' vol. i., pp. 209–355) has given a still more full description, accompanied by rather rude outlines of all the lower range of capitals. There is small need, therefore, for anything more than a mere catalogue here, which it seems to me may be of service to some of those who are able to look at the Ducal Palace, but unable to carry with them any of the weighty volumes to which I have referred.

South-east Angle.—Above the capital is the Drunkenness of Noah. Above this, on a level with the traceries of the upper arcade, the Archangel Raphael, with Tobit, who bears a scroll with these words—

EFICE Q̄
SO . FRE
TV̄ . RAFA
EL . REVE
RENDE
QUIETU.[1]

Capital I. Partly built up. Has three figures of nude children, one with a comb and shears, another with a bird. The foliage is good; but the nude figures have the appearance of semi-Renaissance work.

II. Partly built up. Large birds—one devouring a serpent, another a fish, and the third pluming its feathers. The foliage here is not very good, and the design of the capital in no way first-rate, the birds being treated in a very naturalesque way.

III. Partly built up. Large heads, male and female. The man has a helmet, partly of plate, but with chain mail round the neck.

IV. Partly built up. Children, nude, holding (1) a bird, and (2 and 3) fruit.

V. Partly built up. Emperors. This is the first capital which has inscriptions. Those visible are (1) TITUS VESPASIAN IP̄AT; (2) TRAJANUS INP̄E; and (3) (OCT)AVIANUS IP̄ATO.

---

[1] "Oh, venerable Raphael, make thou the gulf calm, we beseech thee!" This figure looks toward the sea and the port.

VI. Partly built up. Large heads, alternated with tufts of foliage, badly carved.

VII. Virtues and Vices. (1) Liberality; inscribed LARGITAS. ME . ONORAT. (2) Constancy; COSTANCIA . SU . NIL . TIMĒS. (3) Discord; DISCORDIA . SU . --- DISCORDANS. (4) Patience; PATIENTIA . MANET . MECUM. (5) Despair; DESPERACIO . MORS . CRUDELIS. (6) Obedience; OBEDIENCIA . A . DNO . EXIBEO. (7) Infidelity; INFIDELITATE. — ILI . GERO. (8) Modesty; MODESTIA . ROBŪ OBTINEO. This capital should be compared with No. XXVIII The foliage here is very beautiful; but the execution of No. XXVIII. is best.

VIII. Monsters, generally with musical instruments. A riding figure here wears chain armour. There are no inscriptions on this capital, and its intention is very obscure.

IX. Virtues. (1) Faith; FIDES . OPTIMA . IN . DEO. (2) Fortitude; FORTITUDO. 'SUM. VIRILIS' (Mr. Ruskin), or 'INVINCIBILIS.' (3) Temperance; TEMPERANTIA . SUM . IN . OMĪBŪ. (4) Humility; HUMILITAS . ABITAT . Ī . ME. (5) Charity; KARITAS . DEI . MECŪ . EST. (6) Justice; REX . SUM . JUSTICIE. (7) Prudence; PRUDENTIA . METIT . OĪA. (8) Hope; SPE . HABE . IN . D̄NO. The differences between this capital and No. XXIX. are very slight. In the latter, Prudence has a book, which she has not here; and Temperance has a jug here in addition to the chalice which the other carries.

X. Vices. (1) Luxury; LUXURIA . SUM . ĪMENSA. (2) Gluttony; GULA . SINE . ORDINE . SŪ. (3) Pride; SUPERBIA . PREESSE . VOLO. (4) Anger; IRA . CRUDELIS . Ē . IN . ME. (5) Avarice; AVARITIA . ANPLECTOR. (6) Idleness; ACCIDIA . ME . STRIGIT . (7) Vanity; VANITAS . IN . ME . HABUNDAT. (8) Envy; INVIDIA . ME . C̄OBVRIT. This capital is very finely sculptured.

XI. Birds. Some web-footed, some not so; and with no inscriptions.

XII. Virtues and Vices. (1) Misery; MISERIA. (2) Cheerfulness; ALACRITAS. (3) Folly; STULTICIA . E . REGNAT. (4) CASTITAS (CE)L(EST)IS . Ē. (5) Honesty; (HO)NEST(ATEM . DILIGO). (6) Falsehood. (7) Injustice; INJUSTICIA . SEVA . SU . (8) Abstinence; ABSTINĒCIA . OPTIMA . E. This capital is so much damaged as to be hardly intelligible without comparison with No. XXXIII.

XIII. Lions' heads, large and coarse, and with very poorly carved tufts of foliage between them.

XIV. Wild animals. The whole of the beast, not the head only, is given. They are poorly carved and designed.

XV. Damsels and Youths. Considered by Selvatico, and after him by Mr. Ruskin, to represent Idleness. There are no inscriptions. More probably they represent the youth of the higher class with marks of their sportive occupations. This is an extremely well-carved capital.

XVI. Eight large heads alternately with tufts of foliage. The whole finely carved and designed. Supposed by Zanotto to represent the foreigners who traded with Venice. Selvatico describes it as representing Latins, Tartars, etc., and as being, in fact, a repetition of No. XXIII. (*vide infra*).

XVII. Philosophers. This is very much damaged, and the inscriptions are nearly destroyed. (1) Solomon. (2) Priscian. (3) Aristotle. (4) Tully. (5) Pythagoras. On a label carried by this figure Mr. Burges reads the date 1344. Mons. Didron interprets it 1399; this is a date, however, which he will not admit, believing the real date to be 1299. Mr. Ruskin does not appear to have seen these figures, and I have been unable to satisfy myself about them.

XVIII. This is the angle capital. Above it is the Temptation of Adam and Eve; and on the second stage, the four winds on the capital of the arcade, and the Archangel Michael above. The whole is a perfectly beautiful group of sculpture, of an equally beautiful and well-selected story.

Planets. (1) Creation of Man; DE . LIMO . DS̄ . AD̄A . DE . COSTA FORMAVIT . ET . EVA. (2) Saturn; ET . SATURNE . DOMUS . EGLOCERUNTIS . ET . URNE. (3) Jupiter; INDE . JOVI . DOMA . PISCES . SIMUL . ATQ . CIRONA. (4) Mars; E . --- ARIES . MARTIS . ET . ACU --- E . SCORPIO . PARTIS. (5) The Sun; EST . DOMU . SOLIS . TU . QUOQ . SIGNE . LEONI. (6) Venus; LIBRA . CU . TAURO . VENUS . --- T . PURIOR . AURO. (7) Mercury; OCCUPAT . ERIGONE . STILBONS . GEMIUQ. LACONE. (8) The Moon; LUNE CANCER . DOMUT . PBET . Ī . ORBE SIGNORIO. The whole of the sculpture of this capital deserves careful study. Mars is a figure in chain mail. Venus, seated on a bull, and the Moon — a female figure in a boat, with a crescent in one hand and a crab in the other — are both of them exquisitely treated.

XIX. Artificers. Figures alternately crowned and uncrowned working at parts of a building. The foliage is admirable. The pieces of stone on which the artificers are at work are inlaid with porphyry. Mr. Ruskin points out that all the architectural details represented are such as would be found in the early part of the fourteenth century. It is certainly very curious that among the workers one has 'DISCIPULUS OPTIMUS,' another — 'DISIPŪLS INCREDŪL," over the head: a reference to S. John and S. Thomas, which is not intelligible to me.

XX. Beasts. Eight large heads, well carved, and set as knops below masses of rather heavily treated leaves. The beasts have their names inscribed: LEO. LUPUS. URSUS. MUSIPUL. CHANIS.[1] APER. GRIFO. VULPUS.

XXI. Trades. Finely carved. Inscriptions over the heads of the workmen: (1) LAPICIDA SUM. (2) AURIFICES. (3) CERDO SUM. (4) CARPENTARIUS SUM. (5) MENSURATOR. (6) AGRICHOLA. (7) NOTARIUS SUM. (8) FABER SUM.

XXII. The Ages of Man. A very interesting capital. (1) + LUNA . D̄NAT . IFANCIE . P . ANO . IIII. (2) MĒCUREŪ . DN̄T . PUERICIE . P . ANO . X. (3) ADOLOSENCIE. (VEN)US . P . AN . VII. (4) INVENTUTI . DNT . SOL . P. AN . XIX. (5) SENECTUTI . DN̄T . MARS . P . AN . XV. (6) SENICIE . DN̄T . JUPITER . P . ANN . XII. (7) DECREPITE . DN̄T . SATN̄ . UQ̄ . AD . MŌTE. (8) ULTIMA . E . MORS . PENA PECATI.

XXIII. Nations. This is treated in the same way exactly as No. XX. The heads are inscribed, LATINI. TARTARI. TURCHI. ONGARI. GRECI. GOTI. EGICY. PERSII. It will be found that, counting from the south-west angle, the second and fifth capitals on each front are of the same description, i. e. Nos. XIII. and XVI. on the west side, and XIX. and XXIII. on the Piazzetta-front. I think this militates against Mr. Ruskin's view that this capital is not old, as it shows how very regularly they are placed; and I do not see much to choose between in these four capitals. It is worth notice here that this capital is, to a considerable extent, a replica of No. XVI.; but the latter has no inscriptions.

XXIV. Love and Marriage. This is a much larger column than the others. It carries a cross wall above, so placed as to allow of rooms on the sea-front, about sixty-three feet in width. It is one of the most exquisite of all the series. The subjects are: (1) A young man with his hand on his heart, admiring a damsel. (2) They meet and converse. (3) She puts a crown on his head, and presents him with an apple. (4) They embrace. (5) The marriage bed. (6) They hold their bambino wrapped in swaddling clothes between them. (7) The child grows, and enjoys life. (8) The child is dead, and his parents mourn over his body. The change in character from the extreme smartness of dress in the earliest subjects to the carelessness about it in the last, should be observed.

Above this capital is a figure of Venice personified, in one of the divisions of the tracery. She is seated on lions' backs, with her feet above the sea.

XXV. Labours of the Months. This is not a replica. (1) March; MARCIUS. CORNATOR. (2) April and May; APRILIS + MAGIUS. (3) June; JUNIUS . CŪ . CERISIS. (4) July and August;

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[1] Mr. Ruskin founds an argument on the introduction of an H in this way, in what he calls one of the Renaissance capitals of the Piazzetta (the 33rd). He omits to notice its use in this undoubtedly early capital.

Julius + Augustu. (5) September; Septebe. Supeditat. (6) October and November; Octobe + Novembe. (7) December; Decem - - - cat suum. (8) January and February; Janvarivs + Februarū.

XXVI. Sports and employments of damsels and young men. This is a replica of No. XV. The foliage here is exquisitely carved. There are no inscriptions. The figures, as in the other, hold: (1) A horse. (2) A bird, and the leg of a larger bird (hawking?). (3) A distaff. (4) A dog. (5) A flower. &c. &c.

XXVII. Fruit in baskets. This is not a replica. It is the finest of the "knop" series of capitals. The fruit is admirably carved, and here the exact imitation of nature in the fruit, combined with foliage in the knops between the baskets, which is quite conventional and architectural in its character, is extremely interesting and instructive, as showing how distinctly the sculptor knew the proper limits of conventional and realistic representation. The fruit are described: (1) Cherries; Serexis. (2) Pears; Piri. (3) Cucumbers; Chocumeris. (4) Peaches; Persici. (5) Gourds; Cuche. (6) Melons; Moloni. (7) Figs; Figi. (8) Grapes; Huva.

XXVIII. Virtues and Vices. This is a replica of No. VII. The differences are very small. Here H is prefixed to the "ONORAT" of the other capital.

XXIX. Virtues. A replica of No. IX.

XXX. Vices. A replica of No. X., but well deserving study.

XXXI. Monsters. A replica of No. VIII., but very rudely carved, and very inferior to the next.

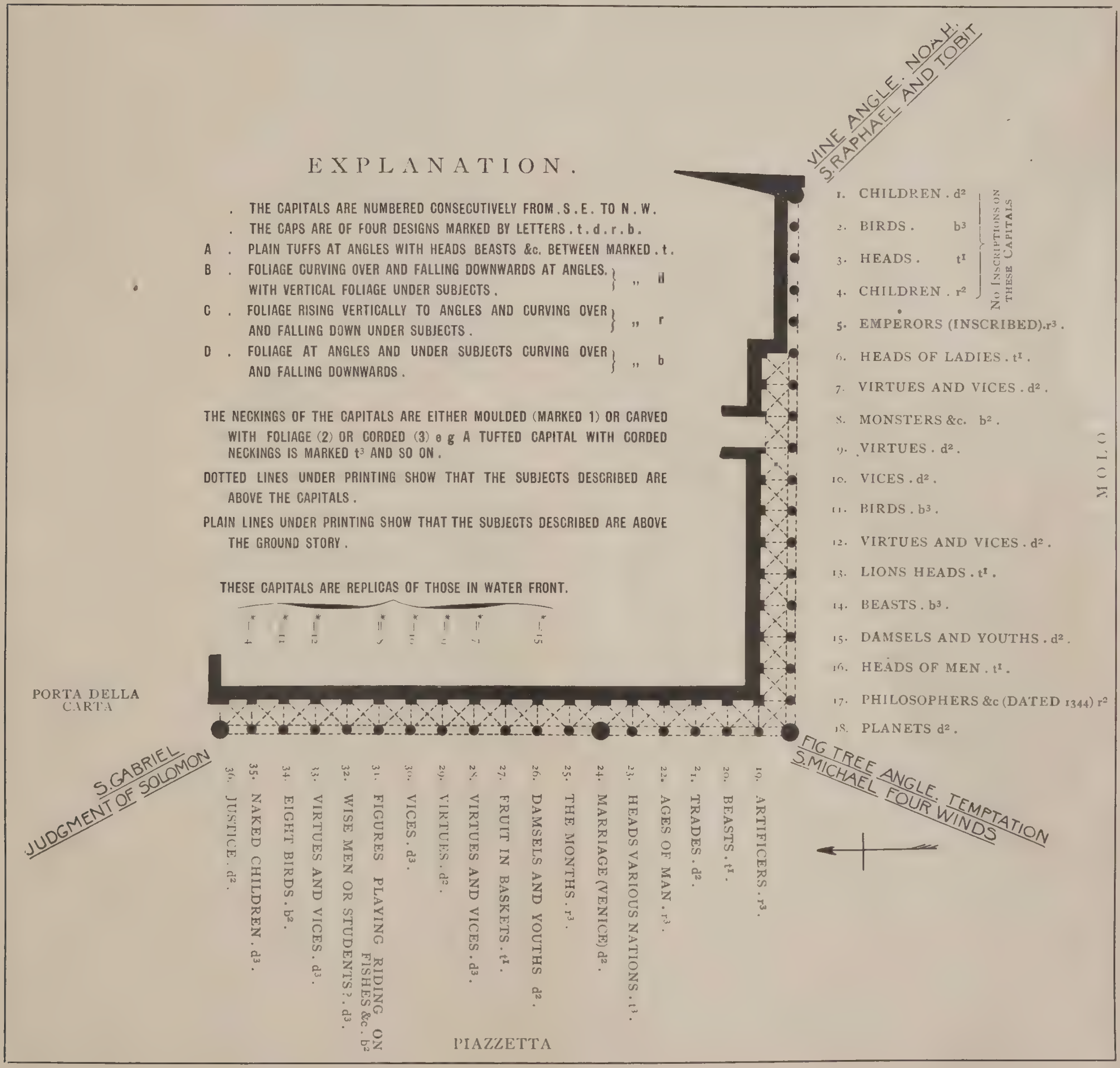
XXXII. Students. This is *not* a replica of No. XVII. The figures are admirably treated, all looking thoughtful, and some holding foliage. It seems to represent the more thoughtful side of youth ascompared with the idle side, represented in the capitals XV. and XXVI. Zanotto supposes the figures to be the seven wise men of Greece; but the eighth figure — a woman speaking — does not lend itself to this. Mr. Burges most ingeniously suggests that it refers to Nouvella d' Andrea, who, in her father's last illness, lectured from behind a curtain to his pupils; her father died in 1348.

XXXIII. Virtues and Vices. This is a replica of No. XII.

XXXIV. Eight birds. A replica of No. XI.

(*Continued on page* 187.)

Key Plan of Capitals Ducal Palace, Venice.


EXPLANATION.
. THE CAPITALS ARE NUMBERED CONSECUTIVELY FROM . S . E . TO N . W .
. THE CAPS ARE OF FOUR DESIGNS MARKED BY LETTERS . t . d . r . b .
A . PLAIN TUFFS AT ANGLES WITH HEADS BEASTS &c. BETWEEN MARKED . t .
B . FOLIAGE CURVING OVER AND FALLING DOWNWARDS AT ANGLES. WITH VERTICAL FOLIAGE UNDER SUBJECTS . " d
C . FOLIAGE RISING VERTICALLY TO ANGLES AND CURVING OVER AND FALLING DOWN UNDER SUBJECTS . " r
D . FOLIAGE AT ANGLES AND UNDER SUBJECTS CURVING OVER AND FALLING DOWNWARDS . " b
THE NECKINGS OF THE CAPITALS ARE EITHER MOULDED (MARKED 1) OR CARVED WITH FOLIAGE (2) OR CORDED (3) e g A TUFTED CAPITAL WITH CORDED NECKINGS IS MARKED t³ AND SO ON .
DOTTED LINES UNDER PRINTING SHOW THAT THE SUBJECTS DESCRIBED ARE ABOVE THE CAPITALS .
PLAIN LINES UNDER PRINTING SHOW THAT THE SUBJECTS DESCRIBED ARE ABOVE THE GROUND STORY .
THESE CAPITALS ARE REPLICAS OF THOSE IN WATER FRONT.
VINE ANGLE. NOAH. S.RAPHAEL AND TOBIT
1. CHILDREN . d²
2. BIRDS . b³
3. HEADS . t¹
4. CHILDREN . r²
No Inscriptions on these Capitals
5. EMPERORS (INSCRIBED). r³ .
6. HEADS OF LADIES . t¹ .
7. VIRTUES AND VICES . d² .
8. MONSTERS &c. b² .
9. VIRTUES . d² .
10. VICES . d² .
11. BIRDS . b³ .
12. VIRTUES AND VICES . d² .
13. LIONS HEADS . t¹ .
14. BEASTS . b³ .
15. DAMSELS AND YOUTHS . d² .
16. HEADS OF MEN . t¹ .
17. PHILOSOPHERS &c (DATED 1344) r²
18. PLANETS d² .
MOLO
FIG TREE ANGLE. TEMPTATION S.MICHAEL FOUR WINDS
19. ARTIFICERS . r³ .
20. BEASTS . t¹ .
21. TRADES . d² .
22. AGES OF MAN . r³ .
23. HEADS VARIOUS NATIONS . t³ .
24. MARRIAGE (VENICE) d² .
25. THE MONTHS . r³ .
26. DAMSELS AND YOUTHS d² .
27. FRUIT IN BASKETS . t¹ .
28. VIRTUES AND VICES . d³ .
29. VIRTUES . d² .
30. VICES . d³ .
31. FIGURES PLAYING RIDING ON FISHES &c . b²
32. WISE MEN OR STUDENTS ? . d³ .
33. VIRTUES AND VICES . d³ .
34. EIGHT BIRDS . b² .
35. NAKED CHILDREN . d³ .
36. JUSTICE . d² .
PORTA DELLA CARTA
S.GABRIEL JUDGMENT OF SOLOMON
PIAZZETTA

THE ART OF BUILDING AMONG THE ROMANS.

Translated from the French of Auguste Choisy by Arthur J. Dillon.

PART II.

CUT STONE MASONRY AND ROMAN FRAMING.

FIRST CHAPTER.

MONOLITHIC LINTELS.

WHEN the Greeks gave to their edifices the heavy proportions which are characteristic of the first periods of their architecture, the short inter-columniation, and especially the great depth of the architraves, guaranteed their stability; in these massive buildings the limits of resistance of the stones were far from being reached, and no artifice seemed necessary to avoid overloading. But when, in the sixth century before our era, the increase in wealth and the desire for refinement led the Greeks to build monuments which were both larger and of lighter proportions, their architects saw with anxiety the chances of rupture multiply, and sought to reduce them. They conceived the idea of setting the stones on the edge of the strata when they were intended for architraves or lintels whose loads seemed excessive. The Romans adopted this ingenious idea, and we will study in their natural order its applications in the two styles of architecture, taking as a first example the great temple of Pæstum.

The stone of which this monument is constructed is travertine with well-marked strata. It can stand great pressure if it is laid on its quarry or natural bed (Fig. 73a); but, used for lintels or for beams supported only at the ends, it can be advantageously employed only under the condition of having its strata vertical, that is, of being set on edge (Fig. 73b).

Profiting by this, the architects of Pæstum set the stones, according to their use, in two different ways, the ones on their natural beds, the others on edge; and all those that were used as lintels were set on edge. The expedient is worth being emphasized, and, not contenting ourselves with indicating it in general terms, it is quite proper for us to verify it by examining one by one the different parts of the edifice (Plate XXIV., Fig. 1). The question is, then, what stones at Pæstum have to resist transverse strains, and how are these stones set.

1st. Of the exterior architrave A there can be no doubt; it should be and it is constructed of stones set on edge, the strata parallel to the vertical faces.

2d. The architrave B, which crowns the upper order of the cella, carried the weight of a roof. The form and extent of this roof is of no importance; entire or partial, it existed; and, directly or by means of some intermediary, it bore on the architrave and tended to deflect it; therefore the stones of the architrave should have been set on edge, and that is what we find to be the case; the section of these stones is an exact square.[1]

Hence, it made no difference, as far as expense was involved, whether the stones were set one way or the other. Would the architects have adopted this unusual way of placing the stones if they had not seen, as a result of it, some increase in strength?

The molded slab C, which is interposed between the architrave and the roof, had to resist crushing only; hence, it is set on its natural bed.

That stones in the exterior frieze are found to be on edge is a detail that carries no conclusion; the frieze was, above all, decorative, and in cutting it the principal object was to obtain the smoothest possible faces, which could best be done by taking the stone in the direction of the grain. This, then, cannot be used as an argument against our theory, so let us pass to the consideration of the stones which form the architrave of the lower order of the cella.

These stones had a tendency to bend under their own weight, and at the same time were compressed between the columns they carried and the columns that carried them. Hence, there were conditions that imposed two contrary courses, but, as the latter stresses were clearly the greater one, the stones should have been laid on their natural beds; and it is thus that they are found.

When the matter is thus put there can be no hesitation in holding that the course followed by the Greeks was entirely correct; yet it may be asked if a third condition did not enter into and make the question more complicated. I have shown the floor at the level of the architrave D, and there can be no doubt that it once existed; but is it so certain that it was carried on special beams, as I have represented it? The boards or slabs of which it was made have disappeared, and it may have been that they rested directly on the architrave. In this case the architrave would have had to resist another transverse strain; and in proportion to its importance the preceding reasoning would still hold good or would be more or less invalidated. Hence, it is only by deciding how the floor was really carried that we can decide how far the use of stone on edge by the architects of the great temple was the result of system.

Happily, there can be no question of its position; the upper architrave is surmounted by a cornice with moldings on both faces, while the lower architrave is ornamented on one face only,— the one toward the interior of the building. From this we must conclude that both faces of the upper architrave were visible, and that the unornamented face of the lower one was concealed; and there was nothing to conceal it, unless it was the floor in the position in which I have shown it in the drawing.

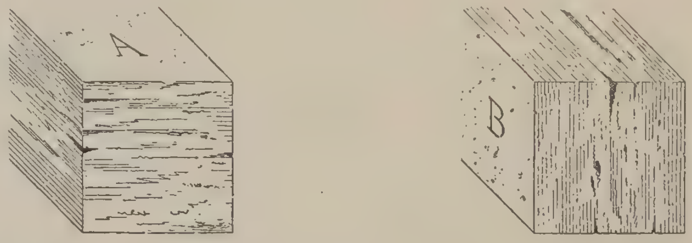


FIG. 73.

This conclusion is still farther strengthened if the analogies between the temples of Pæstum and of Egina are considered. The two temples are alike in every way,— the same general plan; the same division of the cella into aisles by two-storied colonnades; the same methods of cutting the stone; and at Egina, just as at Pæstum, the architrave of the lower order is profiled on only one face (Plate XXIV., Fig. 5). But at Egina there is an indication of the position of the floor that is missing at Pæstum, for the beams that carried it were let into the architrave and the mortises still remain (same figure, tenons K). Assuredly the position was the same at Pæstum, and the architrave had no cross strain to resist other than that of its weight, and, as there was considerable pressure on its extremities, it was better to place it on its natural bed.

This, shown in the above remarkable instance, was the only expedient adopted by the ancient Greeks to increase the strength or span of their monolithic lintels. The Romans, though acquainted with the system of arched construction, recurred in more than one case to the use of stone on edge; and the perhaps most notable example of their application of it is found in the architecture of a country where Greek traditions had a dominant influence,— Provence.

The amphitheater of Arles has about its entire circumference a two-storied corridor, whose upper story is vaulted by a series of barrel vaults supported on large lintels, with their axes perpendicular to the axis of the gallery (Plate XVII., Fig. 1). This arrangement is justified by the general economy of the edifice, by conveniences of plan into which we need not enter; but, considered as a matter of construction, it had the disadvantage of bringing the weight of the barrel vaults onto lintels which could not be built up of keys without producing unbalanced thrusts against the piers, and which could not be made in a single piece without the risk of rupture. The Romans judged that the second risk was the less, and made the lintels monolithic, but they took care to place them in the position that would make their resistance greatest, — for all the stones AB, CD, are on edge. This, moreover, cannot be attributed to chance or to error; there are a hundred of the lintels in place, and without an exception all are set on edge. A circumstance which still further shows the true reason of placing them on edge is that these lintels, as well as those of Pæstum, were cut from blocks of exactly square section (Fig. 74); the width, including the projection of the moldings, is equal to the height; the stone, as brought from the quarry, had equal faces, so there was no reason, as far as the cutting was concerned, why one face should be given preference to another in carving the moldings; it was the question of strength only that decided this; and in the amphitheater of Arles, as in the temple of Pæstum, the same conditions lead to the same solution.

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[1] This can be verified by examining the drawings in the work of M. Aures on the dimensions of the great temple of Pæstum. M. Aures was kind enough to allow me to see the work before its publication; and I have scrupulously followed it wherever I had to show details of architecture which had escaped me in a study made with an entirely different object.

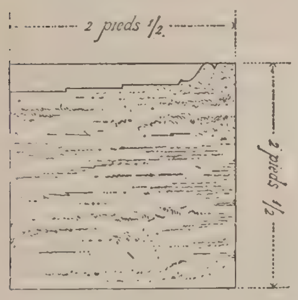


FIG. 74.

It is useless to give other examples after this double verification, which clearly shows the theory which guided the ancients. In profiting by the greater rigidity of stone set on edge, they were able to space their supports more widely; they carried the use of stone lintels as far as possible; in order to obtain greater strength in the lintels, or, to put it the better way, to space the points of support more widely, it was necessary to make a radical change in the system of construction, to abandon the use of monolithic lintels and adopt either the concrete vaults which we have described or the vaults of cut stone which remained to be examined.

(*To be continued.*)

BRICK AND MARBLE IN THE MIDDLE AGES.

(*Continued from page* 185.)

XXXV. Nude children. A replica of No. IV. They have birds, fruit, etc., in their hands.

XXXVI. Justice and Lawgivers. This is the north-west angle column. The capital has the following subjects: (1) Justice; JUSTITIA. (2) Aristotle; ARISTOTEL . CHE . DIE . LEGGE. (3) Moses; ---L . PUOLO . D . L . SUO . ISEL . RITA .[1] (4) Solon; SAL. UNO . DEI . SETE . SAVI . DI . GRECIA . CHE . DIE . LEGGE. (5) Scipio; ISIPIONE . ACHASTITA . CHE --- E . LA . FIA . ARE.[2] (6) Numa Pompilius; NUMA POMPILIO . IPERADOR . EDIFICHADOR . DI . TĒPI . E . CHIESE. (7) Moses receiving the tables of the law; QUADO . MOISE . RICEVE . LA . LEGE . Ī . SUL . MONTE. (8) Trajan; TRAINO . ĪPERADORE . CHE . DIE . JUSTITIA . A . LA . VEDOVA.

The carving of foliage in this capital is, I think, simpler, and on the whole better than that on the other great angle, capital No. XVIII., with which it invites comparison: but the carving of the figures is quite inferior and later in character. The foliage above this capital, which supports the Judgment of Solomon, is inferior to that on the capital itself, and is, I believe, considerably later in date, being no doubt of the same age as the figures in the Judgment, i. e. not earlier than 1430–1450. Above this angle is the figure of the Archangel Gabriel.

THE BRICK ARCHITECTURE OF HOLLAND.

BY R. CLIPSTON STURGIS.

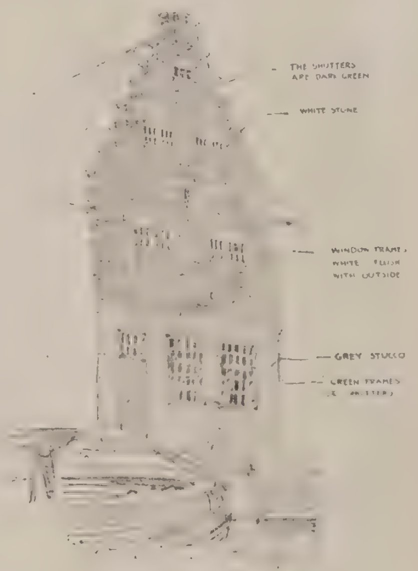
A BRICK WINDMILL : ROTTERDAM.

THE art of a people is so intimately connected with their history and character that it is impossible to form a fair judgment of it without some knowledge of the circumstances and surroundings which have developed that art.

Before we take up the consideration of the architecture of the low countries, it will be worth while to run briefly over the history of the remarkable people who, with no natural resources to aid them, have yet made so great a mark in the history of nations.

Holland as a country is, more than any other in the world, the product of man's ingenuity, industry, and steady perseverance. A more hopelessly unpromising tract of land can hardly be imagined than this, which was little else than the semi-submerged banks of three great rivers which wandered through these low countries and disputed with the sea their possession. Yet this is the country which in Cæsar's day we find peopled by a sturdy, self-reliant race. The Batavians alone of all the northern tribes who came into contact with Rome maintained to a certain degree their independence, and were correspondingly valued by the Romans as allies, and as a nation from whom the most reliable troops could be drawn.

Their country, as I have said, was constantly subject to overflow from the rivers and invasion from the ocean. It was necessary to fortify, as it were, every bit of land in the country, in order to protect it from the turbulent and grasping waters, which were ever ready to find the weak point and rush with ruin over the crops.


THE SHUTTERS ARE DARK GREEN
WHITE STONE
WINDOW FRAMES WHITE FLUSH WITH OUTSIDE
GREY STUCCO
GREEN FRAMES & SHUTTERS

A HOUSE AT HOORN

Such a steady warfare with nature invariably produces a vigorous, self-reliant people, in direct contrast to the people of more favored climates, where crops are produced without exertion. They have so much to contend with, and have so frequently to face disaster, that they are prepared to attain success only through vigorous and unremitting effort. A people who had worked so hard to hold their footing with nature would naturally be disinclined to yield their liberties or rights, and we find them ever an independent, liberty-loving people.

In the days of the Roman power they were, as has been said, practically independent allies; in their later history the Batavian

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[1] Unintelligible; but explained by Zanotto to be: "Mosè che die' legge al suo popolo Israelita."

[2] Zanotto reads this: "Scipione a castita che rende la figlia al padre."

stock predominated and gave the stamp to a people who are practically the Hollanders of to-day. They were, during the early Middle Ages, a barbarous, but a strong and vigorous people, having the German belief in a single God, rather than sharing in Roman polytheism, and according to woman a much higher position than was usual even among the more civilized nations.

The history of this people is the history of magnificent struggles with nature and with man. The courage they gained in the one mastery gave them strength to stand up against imperial Rome and the Cæsars, and against papal Rome and Spain.

Such were the inhabitants of Holland, an independent, free people, who, under Charlemagne, were made part and parcel of the great German Empire; later, when it was dismembered and parceled out into various dukedoms and small sovereignties, these Dutch people, even in those dreary feudal times, kept a considerable amount of liberty, and had their rights and charters which they would yield to none.

There was, however, little national unity up to the sixteenth century. The city was the unit. The municipalities had the wealth and the power, and they were the important elements. It was municipal freedom which was guaranteed by the various codes, statutes, joyful entrances, etc., which were granted them from time to time.

It is significant to note that the earliest of these charters, 1217, granted merely law and order in place of arbitrary judgment; they were making no extravagant demands, they asked merely for justice. This temperance is noticeable in all their later history. Their great leaders against Spain, voicing the people, claimed no freedom from the righteous rule either of church or state. It was misrule against which they revolted. It was "the revolt of the common sense of the better educated among the masses against the terrible abuses of knowledge and power which had been the growth of centuries" (Motley I., 257).

Gradually the cities began to obtain power in state affairs, and gained the right to send deputies to the parliamentary assembly. We realize the enormous growth which liberty had made when we see how violent was the rebound at its first check, when Philip succeeded to the dukedom in 1437. From now on the history of the Hollanders is like the story of some great contest in the Roman arena, in which the little half-submerged country of Holland is the amphitheater where noble suffering and noble deeds find at last their full reward; and the nations of the world are the spectators, who watch with eager interest this struggle for more than life and death and throw occasionally a word of encouragement to the little handful of heroes fighting against such fearful odds to maintain their liberties.

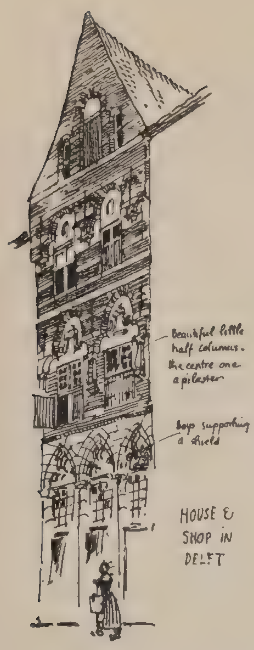
Nor was it only for political freedom that they fought, for from the beginning of the papal claim to supremacy they opposed it and showed a determination to apply the principle of home rule to their religion. This, indeed, led to innumerable vicious sects, but it fostered a spirit of self-reliance which was eminently useful to them in their prolonged struggle. The terrible upheaval of the Reformation came with dreadful force on Holland; nowhere was it welcomed more warmly and nowhere did men suffer more awfully in defense of its principles.

Looking back on those times from this peaceful epoch, one can perhaps see more clearly how truly great and wise were men like Erasmus and Pope Adrian in their endeavors to smooth out the troubles; but it was no time for half-way measures, and the Hollanders, even those, who, like Orange, were at heart faithful Catholics, were committed to yield no jot to the pope. It was the same indomitable spirit of freedom.

During these many and various struggles the masses of the people, the great middle classes, were the mighty factor. They built the cities, dyked their land, traversed the world with their vessels; and when fire and sword or the angry waters destroyed their cities and their dykes, with never-tiring energy they rebuilt them, better, stronger, more beautiful than before. It is a marvel that people so harassed should ever have had time or courage to do more than merely house themselves; yet they did so do, and their monuments of brick and stone are no less enduring than the liberty which they builded so strong and sure.

Politics, religion, art, and literature, all were studied and digested by this versatile people. In the end they acquired full liberty, and sent men imbued with the same liberty-loving spirit to our own country to teach us many a lesson of industry, thrift, and economy, together with the true laws of self-government. As a people they never confounded liberty with lawlessness, but were ever a law-abiding, law-loving people, knowing that only in obedience to law can freedom be found. "Like the actors in our own great national drama, these Netherland patriots were struggling to sustain, not to overthrow; unlike them, they claim no theoretical freedom for humanity, promulgated no doctrine of popular sovereignty." (Motley III., 511.) By the fifteenth century we find Holland a prosperous country, with great wealth and extended commerce, its people well educated and thoughtful, banded together in guilds for mutual protection in their work, and in societies for literary and social purposes — freedom the keynote of their every-day lives. At such a time and to such a people came the fearful struggles with Spain already referred to, and by these struggles such men as William of Orange were developed.

A study of his life and character would be of great value as showing typically what was the best outcome and product of the history of the country, but I cannot take space for this. Suffice it to say that he was eminently moderate and just in all things, not easily


Beautiful little half columns. the centre one a pilaster
Boys supporting a shield
HOUSE & SHOP IN DELFT

aroused, but indomitable in spirit, of a courage which nothing could daunt, neither adversity nor calamity, neither the assault of enemies nor the falseness of friends.

The architecture of a people is a pretty true exponent of their character, and from such a people as we have seen the Dutch to be we may reasonably expect to learn some lesson. I propose to take up three classes of buildings,—*first*, the private house; *second*, the public buildings; *third*, the churches. I take the houses first, because with a law-abiding people the family is the first unit which suggests and forms the municipality and state and both are welded and riveted together by religion.

We may reasonably expect to find the houses of these people to be homes in the true sense, for we have seen them to be a virtuous and sober people, such as make homes and love them. They are, in fact, a homely people. De Amicis, an Italian, writing of modern Holland, was so impressed with the homelikeness of their houses — such a contrast to Italian palaces — that he says, "The true house and home is in Holland. The personal house . . . modest, discreet . . . everything breathes peace and gentleness, and the neighboring steeple announces the hour with a flood of harmony sweet and constant as his affection and his labor." Could he have said this of our stained shingle affairs, which form the suburbs of our cities, and which, save the mark, are the "homes" of a large proportion of our people? Porbably not, any more than he could have called the bells melodious which clang harshly from our steeples.

Even in the dingiest parts of the cities De Amicis found this touch of home life, — "pots of flowers, neat muslin curtains, revealing a poverty not unaccompanied by a love of home and family." I have seen the same myself, and nowhere else have I seen it except in England. It concerns us to inquire what produces this effect, as it is certainly a desirable result to obtain. First and foremost, I think this is due to the fact that the Dutchman builds in permanent materials, showing that his home is to him a lasting possession. I think, too, it is due to a certain honesty of purpose and simpleness of execution, with a plain adaptation of means to an end, accompanied by a sense of the privacy of the home and an humble spirit which makes self-assertion impossible. So when he builds his home it is simple and quiet, unostentatious and honest.

Brick is about the only building material which Holland can produce — there is practically no stone — so the material is brick. Now, when a people like the Dutch undertake to do a thing they do it thoroughly well, and there are no better or more beautiful brick made than those which come from the kilns of Holland. They are perfectly true, with beautiful surface and texture, and in proper proportion. They vary in hardness from the klinkers with which they pave their roads to the soft brick which, though strong and fairly durable, can be sawn, cut, and rubbed; and in color, from black and green to the most brilliant of reds.

When it comes to building, if the owner is a shopkeeper and has his shop in his house, the lower story frankly acknowledges its purpose (but is not on that account iron and plate glass), while his upper stories, gay in summer with flowers, and curtained with spotless muslin, show at once that women and children are there. If it is his dwelling-place only, it is modest, dignified, and unpretentious on the outside; no ostentation, and only such ornament as may serve to indicate its owner's occupation or rank, or give a touch of interest to the façade and make it gay, or a carven verse to show its owner's God-fearing pride in his home and family. If the owner is wealthy, the chances are his house will be hardly distinguished from his less favored neighbor's, except, perhaps, in size. He will tend rather to put his money into beautiful things for the inside of his house, for the pleasure of his family and his friends, than to place ornament on the outside and call undue attention to himself from the general public.

That the Dutch are not selfish in keeping to themselves their treasures, and depriving the poor man of the opportunity to enjoy them,— the argument that is so often brought forward to excuse a vulgar display of wealth on our houses and grounds,— is sufficiently proved by the wealth of their museums.

As I have said, these homelike houses are not barren of ornament outside. There are bits of carving — always in good scale and well placed, by the way,— picturesque gables and dormers, making good skylines and plenty of color. The warm red brick and white stone (often kept gay with paint — a questionable expedient, unless one considers the smoke-blackened alternative), the brick full of all that variety of color which the kilns give us, emphasized by the regular bond, or a diaper pattern, and laid with great nicety, contrasted with gay green and white shutters and doors; polished brass gleaming in the sun, flowers in the windows, and potted trees at the doorstep.

Did you ever notice a little touch of art which shows itself in the way they lay their brick bond as differing from the English? Both use most generally the so-called English bond,— continuous rows, first of stretchers, then of headers. The English lay these rows all alike, but the Dutch break joint with the stretcher rows, thus keeping the same structural strength, but varying the lines of the vertical joints and giving regular diagonal lines which are very pleasing. It adds just that touch of art which we find all through Dutch work when compared with English of a similar period. Where Tudor work is coarse (picturesque and strong, it is true), the Dutch is refined and executed with the skill of an artist, and even where the Dutch run into vagaries, they are such as artists use, and one can well pardon a little frivolity in art to a people who have had so much stern reality in their daily lives.

Fire-proofing Department.

Conducted in the Interest of Building Construction to Prevent Loss by Fire.

A MOST important series of tests, to determine the practical value of the various systems of fire-proofing, is soon to be made, under the direction of the Architectural League of New York, the American Society of Mechanical Engineers, and the fire insurance companies of New York.

The committee under whose direction the tests will be made consists of Mr. S. A. Reed, representing the Tariff Association of New York; Mr. Geo. L. Heins, the Architectural League of New York; and Messrs. H. de B. Parsons and Thos. F. Rowland, Jr., the American Society of Mechanical Engineers.

It is proposed to conduct these tests on a scale never before attempted, and one of the principal things to be determined is the effect of intense heat on structural iron and steel when protected by the different fire-proofing materials.

The committee will keep an accurate record of all data connected with these tests, which will be published in their report.

The committee has organized, and has commenced to build the required plant. There will be a gas-producer, to supply the fuel gas, so arranged to receive a spray of petroleum in case higher temperatures may be required than those obtained from the combustion of the gas alone.

Furnaces for testing full-sized columns and floors will be erected. The foundations of these furnaces will consist of side walls with an arch between them, thus making a safe place for the introduction of the gas pipes and for the hydraulic cylinder. On the top of this foundation will be erected a room built of the materials to be tested. The columns will be loaded by pressure from the hydraulic cylinder, and during the tests a safe load, such as is prescribed by the building laws of this city, will be put upon it. The arches for the floors will be loaded by dead weight. Every precaution will be taken by the committee to make the tests uniform as regards temperature, draught, cooling by water streams, etc., so that the results may be comparable.

A SERIES OF FIRE-PROOFING TESTS.

THE *American Architect* of September 7 contains a very interesting account of a series of fire-proofing tests instituted by Mr. Willard T. Sears, of Boston, and conducted under the direction of Mr. F. E. Cabot, Superintendent of the Boston Board of Underwriters. The report says:—

During the early spring of 1895 a number of test-houses were erected in the basement and first story of a new fire-proof building in process of erection on Boylston Street, in the city of Boston, for the purpose of making a comparison of the value of different materials for fire resistance only.

The tests were instituted by Mr. Sears for the purpose of obtaining accurate data in determining the value of several different systems of fire-resisting construction presented to him for adoption in buildings that he was designing for various uses, viz.: An appraiser's warehouse, 70 ft. by 150 ft., seven stories high, to be occupied by the United States Government; a warehouse 60 ft. by 200 ft., six stories high, for mercantile purposes; a store and office building, 50 ft. by 125 ft., six stories high; an apartment house 106 ft. by 90 ft., eight stories high.

It will be observed that the character of these buildings admitted of a considerable variation in the strength of construction to be used, and the object of the investigation was not only to obtain the lightest construction suitable to meet the requirements for strength and stability, but also to determine fire-resisting qualities that would allow everything of a combustible nature in any room or portion of a building in which a fire might occur to burn out without the fire extending to other portions of the building.

The result of these tests has demonstrated the fact that, where proper care is taken to fill all air spaces and holes in the different stories, especially where the floors join walls and partitions, and where pipes and wires pass through them, a building is practically safe from fire extending beyond the room in which it was ignited, and, in an office building, apartment house, and buildings of like character, if the fire were to be allowed to burn out the contents of the room without water being thrown upon the fire, less damage would probably result than if water were thrown upon the hot plastered concrete, which might crack and become loosened from the metal lathing, and cause damage in adjoining rooms.

One side of each of these houses was built against one of the party walls of the building, which was given a coat of King's Windsor dry mortar, to prevent the fires from scaling the brickwork. The other three walls, floor, and roof were constructed of the material to be tested.

For future reference, these test-houses were numbered 1, 2, 3, 4, 5, 6, 7. Numbers 1, 2, 3, 4, and 5 measured 4 ft. 6 ins. by 8 ft. 6 ins., and were 8 ft. high; these were located in the basement.

An opening 2 ft. by 3 ft. was left at one end of each to admit fuel, and at the opposite end a connection with each was made to 8 in. by 12 in. flues of the building to carry off the smoke.

The roofs of these houses were built between and supported by the first floor beams of the building, and were virtually floors.

The two houses erected on the first or ground floor were numbered 6 and 7, and were each 4 ft. 6 ins. by 8 ft. 6 ins. They were 11 ft. high, and were built of wood.

As in the basement houses, each was provided with an opening at one end, 2 ft. by 3 ft., for the admission of fuel, and was connected by 8 in. by 12 in. smoke flues of the building.

These houses differed in their construction as follows:—

No. 1.—Erected by the New Jersey Wire Cloth Company, according to the Robeling system of construction. Steel studs, 2½ ins. by $\frac{3}{16}$ in., placed 16 ins. on centers, were fastened securely to the basement floor and to the ceiling; these were covered on both sides with stiffened wire lath of their manufacture, and the house was then plastered within and without with two coats of King's Windsor dry mortar.

The roof was constructed of stiffened wire lath, sprung between the first floor beams in the form of an arch, which was covered with a concrete of broken stone, sand, and cement. This was leveled off flush with the tops of the floor beams, giving practically a concrete arch of the depth of the beams (12 ins.) at the springing, and 4 ins. deep at the crown; wire lath was also carried beneath the lower flanges of the floor beams, and the whole ceiling below was plastered with two coats of King's Windsor dry mortar.

No. 2.—The walls of this house were built by the Eastern Expanded Metal Company: Strips of wood, 2 ins. by ½ in., placed 16 ins. on centers, with ordinary stove-pipe iron applied to the 2 in. faces, secured at floor and ceiling (the office of the wood strips being to furnish a simple means of securing the metal lath, ordinary iron staples being used). They were then covered inside and outside with expanded metal lathing, and plastered within and without with two coats of King's Windsor dry mortar.

The roof of this house was built by the New Jersey Steel and Iron Company, and is known as the "Metropolitan Floor." Cables of twisted galvanized iron wires were stretched between the roof beams and fastened to the top flanges by means of a hook of No. 12 copper wire. These cables passed under ¾ in. round iron rods, placed between the beams midway of the span, which gave them a belly-truss form, and kept them taut while the plaster concrete was being applied.

Flat level forms of wood were placed beneath these cables (about 3 ins. below the top flanges). The lower portions of the webs and bottom flanges of the beams were covered with wire netting, so as to form ceiling beams when finished.

Upon and around these forms a composition of plaster of Paris and wood chips was poured, and leveled off 1 in. above the top of the beams. The constructional iron was thus entirely covered with not less than 1 in. of the composition. When it became thoroughly set the wood forms were removed. The ceiling was left unplastered below.

No. 3. — This house was built throughout by the Eastern Expanded Metal Company. The walls were of steel channel bars, studs $\frac{3}{8}$ in. by $\frac{3}{4}$ in., placed 12 ins. apart, secured at floor and ceiling, and covered with expanded metal lathing, and were plastered within and without with two coats of King's Windsor dry mortar, embedding both studding and lath in a solid body of plaster.

The roof was built in two sections: The whole area was first covered with expanded metal, sprung between the beams in the form of an arch. This was covered with a concrete of cinders, gravel, and cement, leveled off 2 ins. above the floor beams, giving a concrete arch about 5 ins. deep at the crown. One section was plastered directly upon the under side of the arch. In the other section $\frac{3}{8}$ in. by $\frac{3}{4}$ in. steel channel bars were secured to the lower flanges of the roof beams and covered below with expanded metal. This was then plastered, giving a flat ceiling.

No. 4. — The walls of this house were built by the Clinton Wire Cloth Company: Studding of $\frac{3}{8}$ in. by $\frac{3}{4}$ in. steel bars, placed 16 ins. apart, secured to the beam flanges, and covered on the outside with Clinton wire cloth of $\frac{1}{2}$ in. mesh. The two end walls were additionally covered on the inside with wire cloth, and the building was plastered throughout with two coats of King's Windsor dry mortar.

The roof of this house was what is known as the "Eureka floor," constructed as follows: —

Wood centers of 2 in. plank were placed 2 ft. on centers between the roof beams, resting upon the lower flanges.

The tops of these centers were level and flush with the tops of beams; the under side was cut in the form of an arch, leaving 3 ins. of wood at the crown. The under side edges of the wood centers were beveled off to $\frac{3}{4}$ in. thickness, and Clinton wire cloth stapled to them. A concrete of gravel, sand, and cement was filled in and leveled off flush with the tops of the floor beams and centers.

These centers gave nailings for the wood floor above. The ceiling below was plastered with two coats of King's Windsor dry mortar.

No. 5. — Was built by the David McIntosh Company, of hollow, porous terra-cotta blocks 3 ins. thick, laid up in common mortar and plastered on both sides with two coats of King's Windsor dry mortar.

The roof was built of 12 in. hollow, porous terra-cotta floor-blocks, plastered below and covered on top with 2 ins. concrete, in which were embedded 2 in. by 4 in. beveled strips to form nailings for wood floors.

No. 6. — The floor was of wood joists 2 ins. by 12 ins., set 16 ins. on centers, upon which was placed first a rough floor of $\frac{7}{8}$ in. matched pine floor boards, 6 ins. wide, then two thicknesses of building-paper, and last a finished maple floor $\frac{7}{8}$ in. thick.

These floor-joists were lathed and plastered on the under side to represent a ceiling of a lower room. Upon this floor were erected walls or partitions of 2 in. by 4 in. studs, placed 16 ins. on centers, lathed with wood laths and plastered in the usual way, King's Windsor dry mortar being used. The roof was constructed in the same manner as the floor.

No. 7. — A floor of 3 in. pine plank splined together was laid directly upon steel I-beams 5 ft. apart; upon this was laid a double thickness of building-paper, and then a $\frac{7}{8}$ in. finished floor of maple.

Upon this floor were erected walls or partitions of 3 in. pine plank splined together and covered on both sides with stiffened wire lath lapped 2 ins. at each joint. The roof was built of 3 in. pine plank splined together and covered on the under side with stiffened wire lath. The whole building was then plastered with two coats of King's Windsor dry mortar.

On the day appointed for the testing a careful examination of the houses was made before the fires were started.

No. 1, which had been plastered early in the spring, was found to be in bad condition, due, no doubt, to the freezing of the plaster. Its representative objected to the fire-test being made, and it was therefore abandoned.

The walls of Nos. 2 and 3, which had stood directly beneath a light-shaft open to the weather, were found to be slightly damp, but otherwise all the houses were in good condition.

At 10 A. M. small fires were started in Nos. 2, 3, 4, and 5 for the purpose of starting draught. At 10.30 cord-wood was thrown upon all the fires, care being taken to distribute the fuel so that the flames should reach every part of the interior of the houses.

At 10.45 A. M. hot fires were burning in Nos. 3, 4, and 5, and by 11 in No. 2, also. The fires were kept at a great heat and at a maximum intensity in each house for one hour, after which time fresh fuel was not added. No water was thrown upon the fires directly, or upon the houses.

Careful notes were taken of any change in the condition of the house during the firing, and after the fires had gone out a careful inspection was again made.

These notes were taken and have been arranged in the form of a comparative table by Mr. H. W. Chamberlain, of Massachusetts Institute of Technology, as follows: —

Test No.	Fire started.	Fire under good headway.	Action during test.	Condition at end of one hour.
2.	10.30 A. M.	11 A. M.	At 11.10 A. M. plaster dropped from brick party wall.	Plaster on expanded metal intact. Brick party wall scaled in a few places from action of fire.
3.	10.30 A. M.	10.45 A. M.	10.45 A. M. There was an explosion. It threw the plaster off expanded metal wall on inside near lower front corner, and from the brick party wall. At 11 A. M. there was a second explosion, which threw the plaster from inside and outside of expanded metal wall near lower front corner, leaving a hole about 2 ins. in diameter. A third explosion threw plaster from inside of expanded metal wall near the bottom.	Ceiling intact. Except on brick party wall the plaster that was thrown off was the second coat. The metal was exposed where the explosion made a hole in the metal wall. The bricks scaled off the party wall after the mortar came off.
4.	10.30 A. M.	10.45 A. M.	10.50 A. M. Plaster dropped from brick party wall.	Ceiling intact. Bricks on party wall badly scaled by action of fire.
5	10 30 A. M.	10.40 A. M.	10.50 A. M. Explosion. Plaster dropped from brick party wall and part of the ceiling.	Brick party wall badly scaled; tile ceiling sustained no injury. Plaster on side wall cracked, but still clung to the wall.

During the fire the outside of the buildings in no case became too hot to bear the hand. The sides and ends of No. 2 and the side of No. 3 were hottest, as would be expected from the construction.

The top flanges of the floor beams above houses Nos. 2 and 5 were cool all through the test. Those above No. 4 were warm, while those above No. 3 were fairly hot. On breaking open the sides of No. 2, it was found that the wood strips in the studding had been charred by the action of the fire to a depth varying from $\frac{1}{16}$ in. to $\frac{1}{4}$ in. deep, according to position in the walls. The tops of some of the studs were charred more than half way through. The floor centers of No. 4, on the other hand, were scarcely charred at all; in no case more than $\frac{1}{10}$ in. deep, and in nearly all cases the wood had not been discolored.

The difference in expansion between the ironwork and the plaster seems to have been inappreciable, as in all cases the plaster adhered closely to the metal.

The explosions referred to may have been occasioned by gases formed by the great heat or by dampness in the materials.

The action of the fire on test-house No. 6 was watched with considerable interest; it had been decided to let the fire burn here until it made its appearance on the outside. The fire was started at

11.45 A. M. The plaster dropped from the brick party wall at 12 M. and from the laths on the rear end near the bottom at 12.05. The laths and studs were well on fire in the rear at 12.10 P. M., and at 12.20 plaster dropped from the ceiling and the wooden side walls. At 12.25 the whole building was thoroughly on fire within; the outside plastering was still intact, although too hot to bear the hand. Later, a crack began to open along the angle at the junction of the end and side walls, which increased steadily until 12.50 P. M. (an hour and five minutes from the time of starting the fire), when flames made their appearance through the crack, and water was immediately applied and the fire extinguished.

On breaking away the exterior plaster on the rear wall of the house, it was found that the laths behind it were all burned away to a height of 6 ft. above the floor.

The studs were also badly burned. The sidewalks were in a similar condition.

The brick party wall was badly scaled over its entire area.

The top floor had been burned away in front near the firing-door, but the under floor was still sound; half way back, the top floor had not been burned through.

In No. 7 the fire was started at 12.27 P. M., and was well under way by 12.50. The plaster dropped from the brick party wall at 12.55, but the plaster on the metal lathing was intact, but red-hot.

At 1.25 P. M. two cracks appeared on the exterior of side wall, where the metal lath was lapped, but neither flames nor smoke had found its way through the house at 2.37 (two hours and ten minutes from the time of starting the fire). It was not thought expedient to carry the test farther, and several attempts were made to extinguish the fire in the walls by throwing water into the houses from hydrant; but, owing to no attempt being made to remove the plaster from the party walls and roof (which remained intact, except the cracks referred to), the planks continued to smolder, protected by the plaster, for forty-eight hours longer, in spite of frequent applications of water upon the plaster.

When the building was torn down, it was found that the planks forming the sides were more than half consumed. The plaster, aside from the drenching it had received, was in good condition.

The top floor had been burned away about half way back from the firing-door, the under plank floor remaining still sound.

The brick party wall was badly scaled over its entire area, showing the intensity of the heat.

A question in regard to the comparative weights of the concrete materials used in the construction of the different roofs having been raised, it was decided to weigh a section of each.

The *débris* from the fires was removed from the houses, the roofs broken down, care being taken to preserve all the material that had entered into their construction, and it was then weighed on platform scales. The data thus gathered are tabulated below:—

Test No.	Construction.	Area of section.	Total Weight.	Weight per sq. ft.
1.	Robeling System.	18 sq. ft.	1,295 lbs.	72 lbs.
2.	Metropolitan System.	18 ,,	427 ,,	23.7 ,,
3.	Expanded Metal Co.'s System.	22.5 ,,	1,697 ,,	75.4 ,,
3*a*	Same as No. 3, with additional flat ceiling.	22.5 ,,	1,814 ,,	80.6 ,,
4.	Eureka System.	20.25 ,,	1,648 ,,	81.3 ,,
5.	Porous hollow tile arch blocks covered with concrete 2 ins. thick.	20.25 ,,	1,781 ,,	87.95 ,,

In considering this table it should be noted that all of the floors were plastered on the under side, and were concreted on top, ready to receive the wood floors. The plastering on No. 5 fell during the fire-test and was removed with the *débris*, and, consequently, not weighed with the other material; the weight of the 12 in. floor-beams is not included in the weight given above.

BRICKS AS A PROTECTION TO IRONWORK.

THERE are so many buildings in London and other large cities which depend for their stability upon a metal framework that experiments carried out with a view to ascertain the effects of a fire upon the iron or steel work of which they are composed cannot fail to be of very great interest to all who are responsible for structures of this character. Experiments were made a short time ago at Vienna, under the supervision of the city surveyor, with the object of testing the efficiency of various building materials against fire, and also to ascertain what protection they were capable of affording to ironwork. To make these tests, a brick chamber some 12 ft. by 8 ft. in plan and 11½ ft. high was built, and in the center an iron column was constructed consisting of two channel-bars, 5½ ins. by 2¾ ins. These channels were placed 2½ ins. apart, back to back, and were braced together with light lattice-bars. Within the space between the channel test-bars, composed of various alloys melting at temperatures between 150 degs. Fahr. and 1.650 degs. Fahr., were placed, the column afterwards being surrounded with brickwork in mortar, thus forming a pier some 18 ins. square. In order that the test should as nearly as possible resemble the conditions met with in actual practise, the column was loaded with a sufficient weight to cause a stress of 3¼ tons per square inch on the ironwork. Fuel was then strewed over the floor of the chamber to a depth of some 3 ft., and the firing was fully maintained for the space of 2½ hours, and was subsequently extinguished by the fire brigade. The heat had, however, been so great that it was not until the next day that a thorough examination of its effect could be made, but it was then discovered that, although the edges of the brickwork pier were crumbled to an extent of 1½ ins., the iron column was quite uninjured, and only the test-bar, capable of fusing at 150 degs. Fahr., showed any indication of melting. It would thus appear that the brickwork was of ample thickness to protect the ironwork, and that when such construction is adopted in actual practise a building is probably as fire-proof as it is possible to make it. — *British Clay-Worker.*

THE *Canadian Architect and Builder*, which has made a most thorough investigation of the causes which led to the complete destruction by fire of the Simpson Building, Toronto, which was considered to be fire-proof, has this to say: The plastering throughout the building was of Acme cement, the columns being also plastered with it on metal lath. This protection would have successfully resisted an ordinary fire in the new building, but was powerless, of course, to resist the intense heat developed in the old adjoining buildings, which were directly connected with the new, without the interposition of any wall.

It has been said of the Simpson Building that the steel columns, which extended from the ground line to the top of the second story, were inadequate to carry the weight of the building, and that the large masonry columns were partly used to give strength to the steel work.

We have made careful inquiry on this point, as it is one of importance, particularly from a structural point of view. Our information shows that the outer walls were carried from the third story entirely on the steel columns, which extended from the ground lines to the top of the second story. These columns were encased afterwards with brick and terra-cotta. The protection of these columns and the beams which they carried was so thorough that paper signs which had been pasted on them were intact when the brickwork was taken down. The stone and terra-cotta of the two lower stories in no way supported the building, and were only a casing or ornamental and protective feature.

Had it been intended to make the building fire-proof, the iron beams, which became so terribly twisted, would have been encased in fire-proof material, such as porous terra-cotta. But this was not done. Profiting by the experience of the late fire, we are glad to learn that the new building will almost certainly be made fire-proof.

Mortars and Concrete Department.

Devoted to Advanced Methods of using Cements and Limes in Building Construction.

AMERICAN CEMENT.

BY URIAH CUMMINGS.

CHAPTER VI.

THE CHEMISTRY OF CEMENTS.

THE question has often arisen and has been discussed with a greater or less degree of intelligence by writers during the past half century concerning the effects of the presence of magnesia in a cement.

The opinions are so various and contradictory as to lead to the suspicion that very little is known about the subject,—a conclusion difficult to disprove if investigation be confined to the purely hypothetical theories advanced.

It may be stated, however, that at the present time the prevailing opinion is that, while magnesia may not be harmful in a natural cement, even though present to the extent of 20 per cent. of the total, yet more than 3 per cent. of the same material is dangerous in an artificial cement.

This is the position taken by many leading authorities on the subject. Others, however, qualify this statement, or, failing to determine the question, leave the subject in doubt and obscurity. While still others maintain that magnesia is a valuable ingredient in a cement.

Prof. E. J. De Smedt, in his annual report to the Engineer Department, Washington, D. C., ending June 30, 1885, states in regard to the composition of a Portland cement: —

"Portland cement is composed of bi-basic silicate of lime and aluminate of lime; sometimes it contains small quantities of magnesia as silicate or aluminate, some oxide of iron, alkali in small quantity, etc. Silicates and aluminates of lime are the principal constituents of Portland cement, the formulas of which to calculate with are as follows: —

$^2CaO.\ SiO^2$ —	Lime	65.12
	Silicic Acid	34.88
		100.00
$^2MGO.\ SiO^2$ —	Magnesia	57.15
	Silicic Acid	42.85
		100.00
$CaO.\ Al2o^3$ —	Lime	67.33
	Alumina	32.67
		100.00

"The magnesia may be calculated as lime when found in small quantities.

"A limestone, such as dolomite, containing 46 per cent. of magnesia, has been pronounced unfit for making good cement, but when the percentage of magnesia is not too large it becomes in time just as hard as a cement containing no magnesia, with this difference, that it is somewhat slow in setting. In sea water containing magnesia such cement should be preferred, for the reason that it does not disintegrate in that water.

"After careful analyses, calculations, and comparative tests, I have found that the best results are obtained when the relative quantity of alumina is in the proportion of between one third and one fourth to the total amount of alumina and silica found by analysis. The quality of Portland cement is perfect in proportion as the above formulas are closely adhered to in its composition. Sulphuric acid in more than 1 per cent. is detrimental, and a small percentage of alkali, such as soda or potash, adds very much to the virtue of the cement.

"Now, it is not sufficient that the proportions should be correct; it is also necessary that calcination should be at the proper degree of heat and length of time, in order to produce the formation of bi-basic silicate of lime and aluminate of lime."

Prof. S. B. Newberry, a leading authority on Portland cement in this country, in a paper prepared for the United States Geological Survey and published in Mineral Resources of the United States for 1892, states: —

"Late experiments by Erdmenger and others seem to prove that magnesia is an inert material in cement mixtures, and that this constituent does not combine with silica and alumina after the manner of lime. The injurious effect of magnesia in Portland cement is ascribed to the very slow hydration and expansion of the free magnesia contained in the cement, causing cracking of the mass weeks or months after immersion in water. Magnesium carbonate calcined at low heat combines readily with water; that which has been heated to the temperature of the Portland cement kiln becomes hydrated only after the lapse of long periods of time. The harmlessness of magnesia in common hydraulic cement is doubtless due to the readiness and completeness with which it becomes hydrated on mixing the cement with water.

Prof. E. T. Cox, in his Geological Report for the State of Indiana, 1878, page 70, says: —

"For hydraulic purposes the essential constituents of a cement stone are carbonate of lime and silica. By calcination the carbonate of lime converts the silica into silicic acid, which forms a gelatinous mass with acids. Carbonate of magnesia acts in a similar manner to carbonate of lime, and when the two are present in the proper proportions hydraulic energy is uninterrupted, and a stone is formed, of great strength and durability, which consists of a double silicate of lime and magnesia. A portion of alumina is not objectionable in a cement stone in the presence of plenty of carbonate of lime and silica; it enters into combination as a hydrated silicate of lime and alumina. Sulphuric acid, or sulphate of lime, does not promote hardening or setting of the cement, and the same may be said of the oxide of iron. Large quantities of these substances are therefore objectionable, and they may be looked upon as adulterations.

"Since carbonates of lime or magnesia, aided by alkalies, when present, are the active agents during the calcining of the cement stone in bringing about the decomposition of the silicates and forming a silicate that is soluble in acids, it will be interesting to present a tabular arrangement of the ratio of silica to the carbonates of lime and magnesia in the above, and some additional analyses of cement stones that are in common use: —

ANALYSIS.

	SILICATES.	CARBONATES.
Balcony Falls, Va.	100	149
Rosendale, N. Y.	100	248
Wabash County, Ind.	100	124
Cumberland, Md.	100	186
Beache's, Clark County, Ind.	100	262
Vassy, France	100	465
English	100	341
Bologne	100	311

"Between the silicates and carbonates, including the carbonates of lime, magnesia, and alkalies, when present, there is a wide variation in cement stones of good repute for hydraulic energy.

"It has already been stated that for hydraulic properties the essential constituents of a cement are silicic acid and caustic lime. The hardening under water is mainly due to the chemical combination of these two constituents *through the agency of water*, producing hydrated silicate of lime; where other bases are present, such as alumina and magnesia, double silicates are formed that become very hard and strong. In order to bring about this chemical change the silica must be brought to that condition which will enable it to form a gelatinous paste with acids. A portion of the silica may be in this condition naturally, but by far the larger portion remains unacted upon by acids until brought to a white heat in the presence of carbonate of lime."

Many years ago, M. Vicat, the famous French engineer, made the following statement: —

"Magnesia is a valuable ingredient in mortars to be immersed in sea water, and if it could be obtained at a cost that would permit of its application to such purposes the problem of making beton (concrete) unalterable by sea water would be solved.

"Without clay, that is to say, without silica, limes cannot be decidedly hydraulic.

"The different combinations I have tried, by mixing chalk and magnesia, have only produced limes susceptible of setting in the commencement, without any ulterior progress; but this solidification, imperfect though it be, denotes in the magnesia certain hydraulic properties which the alumina itself does not possess.

"If, then, some portions of clay be present, it might happen that a triple hydrate of lime, of alumina, and of magnesia might be formed which should possess all the conditions of hardness and of progression which characterize the best hydraulic limes.

"Two species of limestones which were found to contain respectively, before burning, as follows, viz.: —

Clay	4.00	and	5.50
Carbonate of lime	42.50	,,	52.00
,, ,, magnesia	53.50	,,	42.50

yielded limes possessing the hydraulic character in an eminent degree."

M. Parandier stated that "a stone composed of 58 parts of carbonate of lime, 11 of clay, and 31 of carbonate of magnesia yields a very excellent hydraulic lime."

M. Dumas states that "if more than 10 per cent. of magnesia be present, hydraulic limes begin to become poor, and with 25 per cent. they become decidedly poor."

M. Berthier gives the analysis of a hydraulic lime obtained from a mixture of the stone of Villefranche, near Paris, with dissolved silica, in the proportions of 5 of the stone to 1 of the silica.

The analysis of the stone being: —

Carbonate of lime	60.90
.. .. magnesia	30.10
,, ,, iron	3.00
.. .. manganese	6.00
Total	100.00

and the hydraulic lime thus obtained became much harder under water than any even of the natural hydraulic limes.

This mixture after calcination would exhibit by analysis the following: —

Silica	25.83
Lime	44.04
Magnesia	18.50
Oxide of iron	3.88
,, ,, manganese	7.75
Total	100.00

And, as it contains the ingredients in proportions essential to a good hydraulic cement, it is not surprising that it became "harder under water than any even of the natural hydraulic limes."

Again, "when the magnesian limestones found nearer Paris are mixed with one fifth of their bulk of soluble siliceous matter they yield a lime still more energetic in its hydraulic properties than that above described, although the carbonate of magnesia is present in the proportion of 23 per cent."

(*To be continued.*)

VARIOUS SYSTEMS OF CONCRETE CONSTRUCTION.

CONTINUED FROM JULY NUMBER.

CONCRETE AND TWISTED STEEL.

WOODEN FLOOR TOPS.

BY ROSS F. TUCKER.

IT is often a matter of necessity in some classes of buildings, — offices, hospitals, dwellings, etc., — to have a wooden floor over the concrete.

The common method is to build the concrete floors and then to lay 2 in. beveled nailing strips upon this and fill in with common cement. Such a floor, while good enough for many purposes, has, after all, all the objections common to such a construction, — for instance, the loosening of the floor, due to the shrinkage of the wooden nailing strips, the chance for vermin and consequently for fire, the danger of dry rot, and the vibration, noise, splintering, dust, and general wear of the wood, which is particularly rapid in springy or loose floors.

A good precaution to take against shrinkage of the wood strips is to dip them in tar, pitch, or some elastic composition, which, while protecting the wood, will give a splendid bond for the concrete.

The strips should be large and at least 1½ ins. deep, so as to give a good hold for the concrete, which is usually not of very excellent quality.

But the best of all floors of this kind is one in which the separate strips of wood are cemented or glued so rigidly to the solid bed of the concrete as to hold them absolutely tight and rigid, so that there can be no vibration at all.

One day last winter the writer was crossing the common, and in the lower part of it a plank walk had been laid. The water had risen and overflowed the planks at a number of places, and they had become imbedded absolutely rigid in the ice. It was astonishing to walk upon those boards and note the softness of the walk — as soft and easy to walk upon, in fact, as the finest of moquette carpets. The planks were so held that there was not the least vibration, and the noise was almost wholly done away with. The same thing is observable in walking upon the stump of a great tree or any stick of timber of such dimensions as to be free from vibration.

The principle has been adopted quite extensively in Europe, and recently in this country, in the laying of wooden floors.

One method is to construct a concrete floor under any of the various systems. Bring the surface to an even and level grade, and before the top has set groove it out so as to form a series of dovetailed grooves or slots.

The floor top consists of strips of hard pine, oak, or any suitable wood, from 8 to 12 ins. long, and 2 ins. wide, and 1½ or 2 ins. thick. These strips are also grooved on the under side similarly to the concrete.

On the concrete floor is then spread a layer of elastic cement, which is poured into the grooves of the cement, and into which the wooden strips are pounded until the grooves in the wood are also filled.

The cement hardens, and the strips are held tight and fast to the solid cement, precisely as the planks were in the ice, only with a better bond. The top of the floor is then finished and rubbed down to a smooth surface.

It is said that such a floor will outlast several mosaic or marble tops, and where a soft floor is essential, as in hospitals, asylums, and the like, there is none that can compare with it for ease and comfort. A great many are used in England in the post-offices, schools, colleges, banks, churches, hotels, and public buildings, and it is being used extensively, the writer is told, in the St. Luke's Hospital in New York and elsewhere.

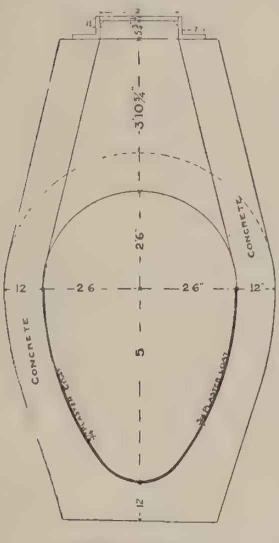
In the next article will appear some cuts of this method of floor work, as well as for forming flat ceilings, as described heretofore.

PORTLAND CEMENT CONCRETE.

THE use of Portland cement concrete has become so general in the erection of large buildings that it is probably familiar to all. In many large buildings recently erected this concrete has been used exclusively in the foundations, in place of brick or rubble masonry, with a great saving in money, time of construction, and durability of the work; but the greater field for the use of Portland cement concrete, viz., culverts, sewers, and small buildings suitable for manufacturing purposes, has been generally neglected. With possibly the exception of Ransome and a few others, nothing much has been done in this country towards the erection of concrete buildings.

The Pennsylvania Railroad Company during the past year built concrete culverts under their roadbeds, in place of the stone culverts used previously. Mr. Jos. U. Crawford, chief engineer of branch roads, informed the writer that he considered the use of Portland cement concrete very advantageous for this class of work. The work can be pushed forward very much quicker than with brick or rubble masonry, and costs but one half. The abutments of these culverts were made of one part American Portland cement, one part limestone dust, three parts boiler ashes, and six parts crushed stone; the arch being a little richer in cement. The abutments are 12 ins. thick and the arches 3½ ins. thick at the crown; one has a 2 ft. span and the other a 4½ ft. span. A wire netting, costing five cents per square foot, is stretched over the lagging of the arch and becomes imbedded in the concrete. The limestone dust was used in the concrete as a filler, it being very close at hand and inexpensive.

The city of Reading, Pa., in their new sewers, have adopted Portland cement concrete in place of the old materials, — brick and Rosendale cement, — previously used. This work has been done under the supervision of Mr. E. Chamberlain, city engineer. In Reading the character of the soil is well adapted for concrete construction, being of a clayey nature and enabling the shaping of the sides of the ditch to conform to the outside lines of the sewer section. A section plan at manhole is shown in Fig. 1.



SECTION AT MANHOLE
5'×7'6"
CONCRETE SEWER

From the springing line down, the ditch is excavated to the neat outside lines of the sewer by the use of a templet. After the first 12 ins. of the concrete bottom is made, the inside centers are placed in position, and the lagging, which is made of 2 ins. by 3 ins. by 16 in. strips, is carried up to the springing line with the concrete side walls of the sewer, the layers of concrete being about 6 ins. in depth. The arch centers are then placed in position with the same sized lagging. The outside surface of the arch is given the proper shape by bracing 4 in. or 6 in. strips to the sides of the ditch. The centers are generally left in place about twenty-four hours, or until all refilling has been done, after which the plaster coat is put on. The following is a copy of specifications for mixing the concrete: —

Concrete shall be composed of one part Portland cement, passing required tests, three parts clean, sharp sand, free from dirt or loam, and six parts of broken stone; stone to be of good quality, free from dirt or clay. Quarry strippings will not be allowed. All stone must be broken so that the longest side shall not exceed 1½ ins. Sand and cement shall be thoroughly mixed dry and then wetted and worked to the satisfaction of the engineer, after which the stone shall be added and mixed with the mortar. The concrete shall then be placed in the work, in layers of not more than 6 ins., and rammed until it flushes. Concrete must be mixed by hand. The concrete must be allowed to set at least twenty-four hours before any refilling is done. The inner surface of concrete sewer must have a finished coat of one part Portland cement, passing required test, to two parts of clean, sharp sand.

CONCRETE STOCK HOUSE, SAYLOR'S PORTLAND CEMENT WORKS.

The work was all done with American Portland cement, and the sewer, which was built last year, is giving entire satisfaction. The cost of the 7 ft. 6 ins. by 5 ft. 0 ins. sewer is about $8 per lineal foot.

There are very often culverts and buildings to be erected by large manufacturing establishments, who have quantities of cheap materials at hand, which could be utilized in concrete, which would very materially lessen the cost of the structure, if Portland cement concrete was used for the construction. In the spring of 1894 Mr. Chas. M. Saegar, A. M. A. S. C. E., built a storehouse and culvert of this construction at the "Saylor's Portland Cement Works," Coplay, Pa. The culvert is about 250 ft. long, and is used to carry the surface drainage from the ground back of the mill, as well as the waste water from the mill to the Lehigh River. In some places it is covered with dirt 20 ft. thick.

The boiler-house and boilers, concrete stock house, and the coal trestle and dump are built on this culvert. Fig. 2 shows section plan of the culvert. The materials used were one part "Saylor's" American Portland cement, two parts clean, sharp sand, and four parts boiler ashes. This was made up in the form of concrete and deposited in a casing made of rough boards, in layers of 6 ins., and in this concrete were imbedded all the large pieces of limestone (strippings of the quarry, unfit for cement making) that could be rammed in; this was covered with concrete and rammed; then another layer of stone was firmly pressed in and again covered with concrete, and so on. The arch was made in precisely the same manner as this, only that care was taken to place the longest line of the stone in line with the radius of the circle. Care was also taken to have 2 or 3 ins. of coating of concrete directly on the boards, so as to show a smooth surface when the centering was removed. The floor of the culvert is made of the ash concrete, about 4 ins. thick.

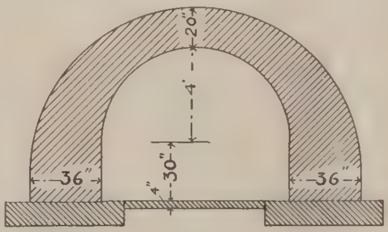


FIG. 2.

The stock house, which is built in the same manner as the culvert, is 250 ft. by 50 ft. The walls are 2 ft. thick for the first 16 ft., up to the second floor; from there up they are 18 ins. thick. The first floor will carry 25,000 bbls. of Portland cement and the second floor 15,000 bbls.

The above method of construction shows remarkable strength, considered with the cheap materials used, and it could be readily utilized to great advantage by many who have such waste materials at hand when building.

WM. G. HARTRANFT.

The Mason Contractors' Department.

Conducted in the Interests of the Builder and the Contractor for Brickwork.

CRACKS IN BRICKWORK AND PLASTERING.

WHAT CAUSES THEM, AND HOW THEY MAY BE PREVENTED. (*Continued.*)

BY A. H. DYER.

An ordinary store-front having a continuous footing of equal width will quite often show the effects of unequal settlement to such an extent as to seriously affect the value of the property, as well as to give the building a reputation of being unsafe. Fig. 8 is an exact representation of the front of a two-story brick building built upon a continuous footing and in the same manner as shown in Fig. 1. The cracks A, B, C, D began to show at about the same time, the two upper ones working toward the corners in a nearly uniform manner. As the corners continued to settle, the outer ends of the lintel settled enough to cause cracks E and F, as shown. As usual, the cause of these cracks was attributed to an insufficient area of footings, the width of same being but 20 ins., and the wall 12 ins. thick the entire height of the building. No part of the weight of the floors or roof was brought to bear upon this wall, and it will be seen that the weight of the brickwork alone for the entire height of the wall would be but 2,180 lbs. upon each square foot of footings, which is considered to be a very moderate load; but at the center of one of the large window openings the load would be but 253 lbs. per square foot, provided, of course, that no weight from the piers on either side was brought to bear upon that point; in a shallow foundation, as in this case, very little if any additional weight would be distributed as far as the center, and in no way would it be possible to distribute an additional weight of 1,927 lbs. per square foot to that point, so that the load would be the same as at the piers or corners, which would be necessary in order to insure an equal settlement in case of any settlement at all, for the simple reason that the weight at that point lacks more than *six tons* of being heavy enough, just the same as shown in Fig. 3, that the "inverted arch" lacks five tons of being heavy enough to take the place of the five tons that had been entirely removed from the wall. In Fig. 9 we have the same width of footings as in Fig. 8, but we have only about *four ninths as much total area of footings;* but we have practically a uniform load for each square foot of footings, and the maximum load per square foot is no greater than that in Fig. 8. If we should increase the width of the footings fifty per cent., making them 30 ins. instead of 20 ins., the load per square foot upon the bottom footings would be decreased fifty per cent., but *the difference in loads would be in the samé ratio as before.* It makes no difference whether the footings are of brick, stone, or concrete, they should be properly proportioned and no part of them should be loaded with eight *times more weight* than other parts of a like area, as is practically the case with Fig. 8. It will be noticed that only the weight of the brickwork and the iron work was taken into consideration when figuring the loads of Fig. 9. The writer recently examined a one-story public building having large double windows near each corner and in both directions from the corner, which gave unmistakable signs of unequal settlement. The building is a handsome one of stone and rests upon a heavy concrete (continuous) foundation, and, although finished but eight months ago, each of the corners shows a tendency to pull away from the building, as shown by the open joints and cracks in the masonry from the walk line up to the window-sills and from the top of the opening up to the top of coping on the side of windows nearest the corners. All corners show these defects in about the same degree; there is a difference of 1,200 lbs. per square foot in the loads of the masonry alone; a 30 in. "cut out" below the center of each double window would have caused the loads to be uniform throughout. The load per square foot at the corners figures 3,031 lbs. for masonry alone, while below the center of the opening the same figures but 1,830 lbs.; with this difference in loads the heavy concrete footing did not enforce an equal settlement, but all four corners of the building proved defective in about the same degree. This is another example of *too much foundation.* A one-story brick and stone depot building but recently completed already shows the same defects as above, notwithstanding the fact that the wall rests upon footing stones *four feet wide, but continuous under all openings.* In the vicinity of all of the above buildings, and upon the very same quality of ground, buildings upon brick foundations, constructed upon the same principles as shown in Fig. 9, stand without a single crack caused by unequal settlement, although some of them have but one half or two thirds as much total area of footings in proportion to the weight of the building as the above-mentioned buildings in which the foundation has proved to be defective.

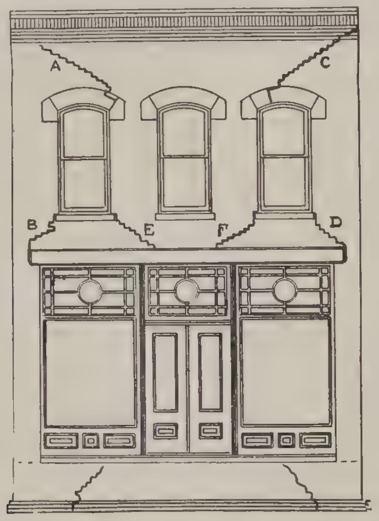


FIG. 8.

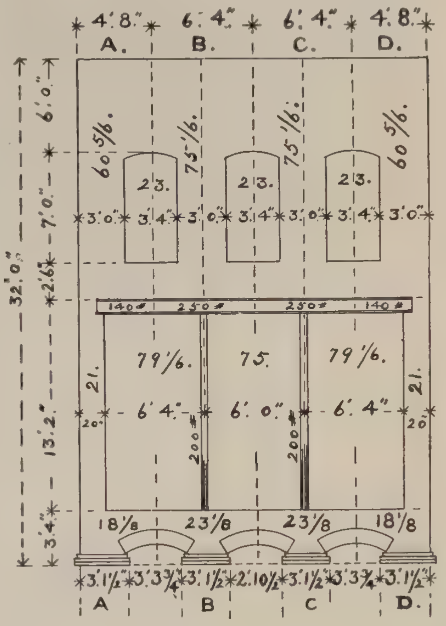


FIG. 9.

Wanted.— A partner, by a mason doing a large and profitable business. Must have $5,000 to invest, and furnish good references. A thorough investigation is courted. Address, Mason, care of The Brickbuilder Pub. Co.

SIDE TALKS WITH THE BUILDER.

THERE are many builders who have a practical knowledge of brickwork and know how to construct an excellent piece of brickwork, but are careless or ignorant regarding that most important part of every building, and that upon which their structure depends most entirely. A poor *stone wall* has been the cause of ruining many a noble and otherwise perfect edifice. Let me give my brother masons a few pointers on laying stone — not that I shall attempt in these columns to give an exhaustive treatise on the subject, but simply to place before him a few simple rules, which may possibly be the means of saving him many dollars.

Of whatever quality the stone may be of which a wall is to be built, it should consist as much of stone and as little of mortar as possible. If it be inferior in durability and power in resisting the action of the atmosphere, etc., to the mortar, besides the certain fact that the mortar will yield until it has set hard, and so far act injuriously, no ulterior good is gained; and if the stone be the more durable material, the more of it that enters into the wall the better. Indeed, in rough walling, if the stones be laid so that the most prominent angles on their faces come into actual contact, the interstices being occupied by mortar, it will be better than if a thick, yielding mass were allowed to remain between them. Absolute contact, however, should not be permitted any more than in brickwork, lest the shrinkage of the mortar in drying leave the stones to such unequal bearing as the prominent parts alone would afford.

Stone being generally of a less absorbent nature than brick, it is not a matter of so much importance that it be wetted before setting. Nevertheless, adhesion on the part of the mortar is more certain and more complete if the stones be worked in, at least, a damp state.

Bond is of not less importance in stone walling than in bricklaying. Instead of carefully making the joints recur one over the other, in alternate courses, as with bricks and gauged stones, the joints should as carefully be made to lock so as to give the strength of two or three courses or layers between a joint in one course, and one that may occur vertically over it in another. In bonding *through* a wall or transversely, it is much better that many stones should reach two thirds across alternately from the opposite side than that there should be a few through stones, or stones extending the whole thickness of the wall. Indeed, one of the many faults of stone masons is that of making a wall consist of two scales or thin sides with through stones now and then laid across to bind them together, the core being made of mortar and small rubble merely. This is a mode of structure that should be carefully guarded against. There is no better test of a workman's tact and judgment in rubble walling than the building of a dry wall, or a wall without mortar, affords.

Walls are frequently built with mortar that without it would have fallen down under their own weight in a height of 6 ft., in consequence of their defective construction, thus rendering it evident that they are only held together by the tenacity of the mortar, which is very seldom an equivalent for a proper bond of stone. Masons are very apt to set thin, broad stones on their narrow edges to show a good face, by which the wall is injured in two ways. It tends to the formation of a mere case on the surface of a wall, and it for the most part exposes the bed of the stone to the atmosphere, as a stone more likely to be broad in the direction of its bed than across it.

One of the severest trials builders have to encounter is the architect, who is well versed in the technical conception or planning of a structure but is not acquainted with its practical construction. I do not, however, make this a sweeping charge, as there are many capable men throughout the country who fully understand the practical side of building construction.

I would urge here, as I have always done, that if the modern architect is to live his highest life, and see the fulfilment of his noblest conception, he must go down into the byways and loiter in the highways, and seek out, learn, comprehend, and be able to apply to his art every handicraft engaged therein.

He must go into minute details of methods, of skilled labor, and even master the mystery of the nineteenth-century mechanisms, which play such a more and more prominent part in all that is done and all that is hoped to be designed.

If the workman be the tool by means of which the design is to be wrought, then he who conceives the design must know most fully the breadth of the skill that is to operate the tool. Indeed, he must have had some experimental knowledge himself before he can conceive and carry out his best work or have others execute it for him. But this is not all. In placing himself in direct contact with the artisan who is trying to interpret his feeling, the artisan catches more and more of the spirit, of the animus, of the creative power which conceived the design; the skill, which, by years of cunning practise, has crept into his hand, and which has developed more by instinct than by an impulse of purely intellectual incitation, becomes quickened by this contact with the finer human fiber, and soon there is a generous rivalry, as between the power of execution and that of conception. When architecture and handicrafts have arrived at such a relation, then shall the world witness the birth of another Phidias, Michael Angelo, Paul Veronese, or Christopher Wren. It may be that this ideal is purely Utopian; but we may promote the good work that would ensue from a more friendly attitude to the handicrafts by taking and showing more interest in the technical execution of architectural work, by requiring better workmanship, and by giving a preference to artisans who take a pride in their skill, and who love, as the architect does, beautiful handiwork.

No architect who appreciates the close relations between the details as the finish of his art and the composition of its entirety as the expression of his ideal but will see how intimate is the connection between the hand that executes and the brain that conceives.

To be in most sensitive touch with this expression, the architect must either be a craftsman himself, modeling with his own finer fingers, or else have that delicate mental insight which can perceive and direct how, and where, and when the alluring line or the subtle surface shall appear.

With the numerous so-called architects grinding out plans by the yard, I am afraid the architectural profession has too much to contend with in this country. The following contents of a professional (?) circular, quoted by an English journal, however, shows a degradation which can hardly be considered amusing. This choice extract reads: —

"As competition is very great in our day, I submit for my clients' approval sketch designs (free of charge) of any class of buildings they intend to erect or are interested in, upon receiving particulars of their requirements."

The circular concludes with the reiterated announcement: "Designs of any buildings sent free of charge."

R. N. BUELL.

SINCE the latter part of the last century the power of the great River Connecticut has been kept in harness at Holyoke, Mass., and from time to time dams have been built, according to the needs of the manufactories on the banks of the river.

A new dam, in the construction of which neither money nor labor is spared, is now being built under the direction of the Holyoke Water Power Company; the contractors for the work being the Fruin-Bambrick Construction Company and Henry S. Hopkins, of St. Louis, Mo. The enterprise was begun in the summer of 1893, and the intention is to build a dam second to none in the world.

It will be 1,020 ft. long and 32 ft. high, with a width of 54 ft., containing 50,000 cu. yds. of masonry; 30,000 horse-power will be furnished by this great dam when completed.

Much time is needed to construct this immense wall of masonry that is to hold back the waters of the river, and three years is the time allowed for its completion.

An immense quantity of cement will be used in this work, and we are informed by Mr. J. N. Sickman, the engineer in charge, that the Alpha Portland cement, an American product, has been specified exclusively.

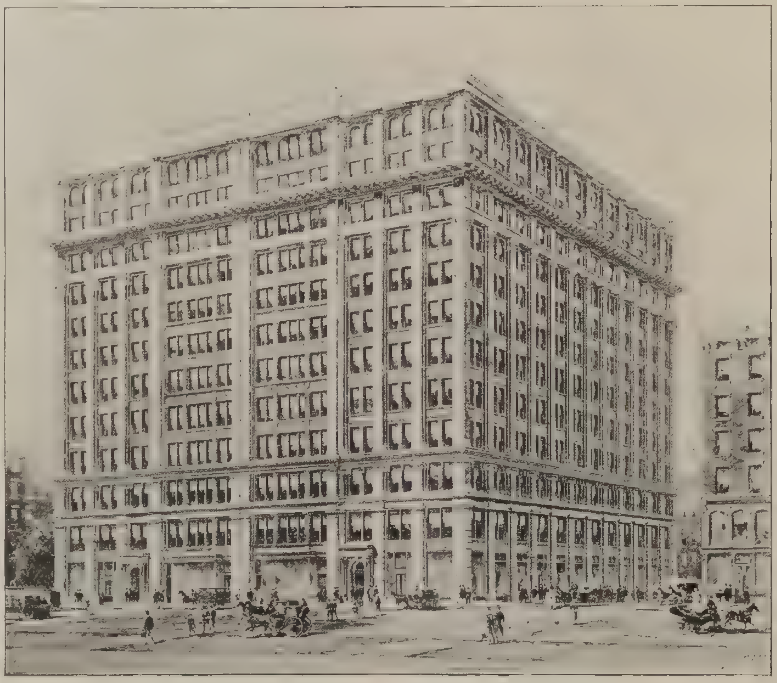
Recent Brick and Terra-Cotta Work in American Cities.

A Department Devoted to the Interests of the Manufacturer.

THE accompanying illustration is of the New York Commercial Building that is now being erected on the site of the old New York Hotel, Broadway, New York City. When completed it will be one of the finest of modern structures. The front is of brick and beautifully molded terra-cotta, there being over five hundred tons of the latter used, all of which is white.

A notable feature in connection with the Broadway elevation is the size of the terra-cotta capitals which are used in the ninth story, they being 5 ft. in height. On Plate 58 is illustrated the scale drawing of the elevation and a group of the terra-cotta capitals used. Mr. Robert Maynicke is the architect, and Mr. Isaac A. Hopper, the builder. The terra-cotta was executed by the Excelsior Terra-Cotta Company, of New York.

CHICAGO. — "Bicycles in architecture" is a subject already demanding a certain amount of attention. Restaurants are advertising "Wheelmen's Rest," and provision for storing wheels must be made in office buildings, clubs, gymnasiums, Y. M. C. A. and even church buildings, not to mention special cycling clubs, buildings for more than one of which are planned or under construction in this city. No wonder an architect's work is fascinating when we think of the constant changes and modifications in modes of living and their direct effect on architecture. These are what makes the history of architecture interesting. Refrigerating machines and elevators are bringing us phases of buildings not dreamed of by Ruskin and Viollet-le-Duc.



NEW YORK COMMERCIAL BUILDING, NEW YORK CITY.
Robert Maynicke, Architect.

The free and easy use of building permits in Chicago has been referred to before in these columns. The latest item of interest was in connection with the proposed Northern Hotel, office and theater building. The permit was refused at first on the double ground that the building is to exceed the limit of height (130 ft.) allowed by the present ordinances, and that the old permit taken out before this ordinance went into effect did not contemplate a theater in the building. Both these points were easily avoided, however, by allowing the hotel and office part of the building to proceed under the three-year-old permit and by issuing a new permit for the theater part of the building, which is itself less than 130 ft. high.

Chicago needs a Roosevelt. Even under the new administration, about which we expressed great hope, it is easy to evade laws; one can build a wood construction bay window in the heart or the business center of the city, or he can project a show window 3 ft. on the most crowded sidewalk, if he only uses a little "oil."

New York has not a monopoly of building disasters. The recent complete collapse here of the "Coliseum," — an amusement building somewhat like the Madison Square Garden, but of a cheaper order, — would have made a great stir had it happened two hours sooner than it did, in which case two hundred men would have been killed or maimed. As it was, not a man was injured when the great steel trusses of the half-finished roof fell one night and made a cyclonic tangle of planking and twisted steel work, and caused a loss of some $75,000 or $100,000. The collapse seems to have been the result of too much "rushing," but whether it was a defective bearing plate on the inclined pile foundation, or an overload of roof lumber on an unfinished truss, or both, does not seem as yet to be determined.

A carriage manufactory at 381 Wabash Avenue has a party wall (still unused from one side) which settled 5 ins. more than the rest of the building, and with such effect that a bay of the front had to be taken down and rebuilt. Miscalculation for foundations on Chicago soil is serious.

An architectural feature of a new office building already mentioned is to be two terra-cotta caryatids, each (probably an Atlas) carrying an eight-story building on his shoulders. Whether the contemplation of this building will give one a backache is an open question; but at any rate the architect protested when the owner insisted on introducing this feature in the design.

The alterations of important buildings in the business part of Chicago outnumber the erection of new ones this year. The removal of tenants to the attractive new office buildings makes it imperative for owners to "modernize" their buildings, since conditions will not justify razing the old structures and erecting others in their stead. Hence the very numerous places about town where jackscrews are in view and new fronts, entrances, and elevators are being put in.

The "Reaper Block" and the "Major Block" are two of the largest buildings undergoing repairs. The fronts are stone in "Renaissance" design. Two or three stories of terra-cotta are added, and the result is so successful (at least, in the case of the Reaper Block, now finished) that one regrets the millions of dollars' worth of substantial and even fire-proof buildings built since the great fire which have lately been torn down to make way for modern office buildings.

A large church, heavy spire and all, is to be moved bodily 50 ft. More particular mention will be made when the feat is undertaken. A number of such difficult projects have been carried out successfully; one that may be recalled was the moving of a 100 ft. square three-story apartment house a block and turning it 90 degrees in transit.

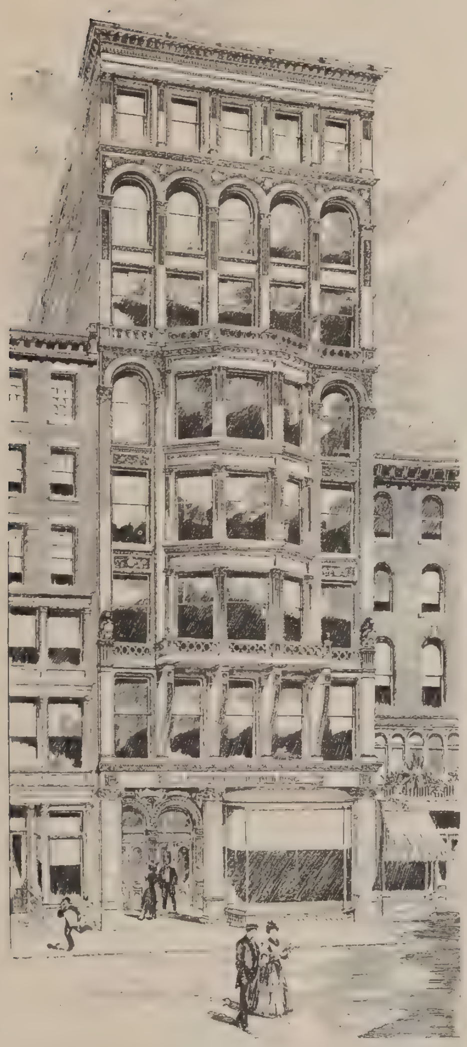
One or two announcements of new buildings are as follows: —

$125,000 apartment building for Judge R. Prendergast, Flanders & Zimmerman, architects. Bedford stone and Roman brick, and terra-cotta trimmings and cornice. No elevators, electric door openers. Bicycle storage.

A new apartment building for Barry & Tellerus, Cowles & Ohrenstein, architects.

The Northwestern Terra-Cotta Company have the contract for the Fisher eighteen-story building.

The American Terra-Cotta and Ceramic Company are furnishing the terra-cotta for the big Yerkes Observatory.



OFFICE BUILDING, 1031 CHESTNUT ST., PHILADELPHIA.
Albert W. Dilks, Architect.

PHILADELPHIA.—A building thoroughly adapted to present uses and rivaling in beauty and utility some of its much more extensive competitors is the one recently finished at 1031 and 1033 Chestnut Street, designed by Architect Albert W. Dilks; it shows more than ordinary study in the planning of the eight floors composing the building, and has an abundance of light and air.

It is constructed with a steel frame between extra heavy party walls, care being taken to thoroughly protect every part of the frame from fire and rust. The stories are very high, probably higher than necessary for the ordinary uses to which they will be put, but were made so in order that there might be freer light and ventilation. Aside from the stairways, which are of iron with aluminum finish, the front on Chestnut Street is the only place upon which any ornamentation could be attempted, and here there has been a combination of stone, brick, and terra-cotta very neatly and carefully designed and executed. The detail especially is better than the usual work of this class, and in the building looks very much more interesting than in our sketch, the position of the building being such that it is almost impossible to get a good photograph of the front at present.

A very noticeable feature is the large vestibule or entrance to the building, which is faced from floor to ceiling with faience in specially designed pattern. The novelty of the material attracts the attention of the passing public, and is quite favorably commented upon. It was furnished by the Grueby Faience Company, of Boston, Mass., and is of the most extensive and finest of their executions which we have seen.

The brick and terra-cotta is from the New York Architectural Terra-cotta Company, while the terra-cotta arches and blocks are from the Staten Island Terra-cotta Company. The elevators are of very high speed, and were erected by the Stokes & Parrish Company. The steel work was made by the Phœnix Iron Company.

The extremely hot weather seems to have had a depressing effect upon the boom which has been running since the early spring, and there is at present more attention given to the buildings now in course of erection than to those projected. There are well-founded rumors of some new, large contracts about to be let; the Mutual Life Insurance Companies, of New York, are about ready to commence, as is also the Baptist Publication Society. Both will be very large buildings. The Harrison and Fidelity Insurance Companies' office buildings and the Hotel Walton are rapidly nearing completion, and the Franklin Building is about finished.

The time for the submission of the competitive drawings for the new Art Museum, in Fairmount Park, is rapidly approaching; they are due on the first of October. A supplement to the original program was issued several months ago, which threw considerable additional light upon the former circular. It is to be hoped that it will be more of a success than some of the recent competitions in our neighboring cities.

Business Change.—The information comes to us that Mr. O. W. Ketcham, formerly of the New York and Philadelphia offices of Fiske, Homes & Co., has opened in his own name an office in the Builders' Exchange in Philadelphia, for the sale of building materials of all kinds, especially brick, terra-cotta, etc. He will continue to represent Fiske, Homes & Co., the Grueby Faience Company, the Excelsior Terra-cotta Company, and the Pennsylvania Enameled Brick Company, in Philadelphia and vicinity, as well as other large houses throughout the country.

MINNEAPOLIS.—The present outlook for building operations is much brighter than at last reports. An immense crop now being harvested gives assurance of an abundance of the necessaries of life, and the money required to harvest and move this crop will give labor and the railway companies all they can do. The impetus thus imparted extends generally and gives all a feeling of assurance that the worst is over. There is a notable increase in elevator construction all over the Northwest. We confidently expect a very considerable increase in the volume of our business before winter sets in.

Warren H. Hayes has planned church building for the Union Square Baptist Society, of Boston, Mass.; 77 by 120 ft., to be built of brick and granite at cost of $35,000.

In residences the following:—

For Charles E. McMullen, an apartment building to contain eight apartments, at cost of $40,000. A. L. Darr, architect.

S. G. Cook is completing a $20,000 residence begun some time ago, and "hung up" during the recent depression; 40 by 70 ft.,

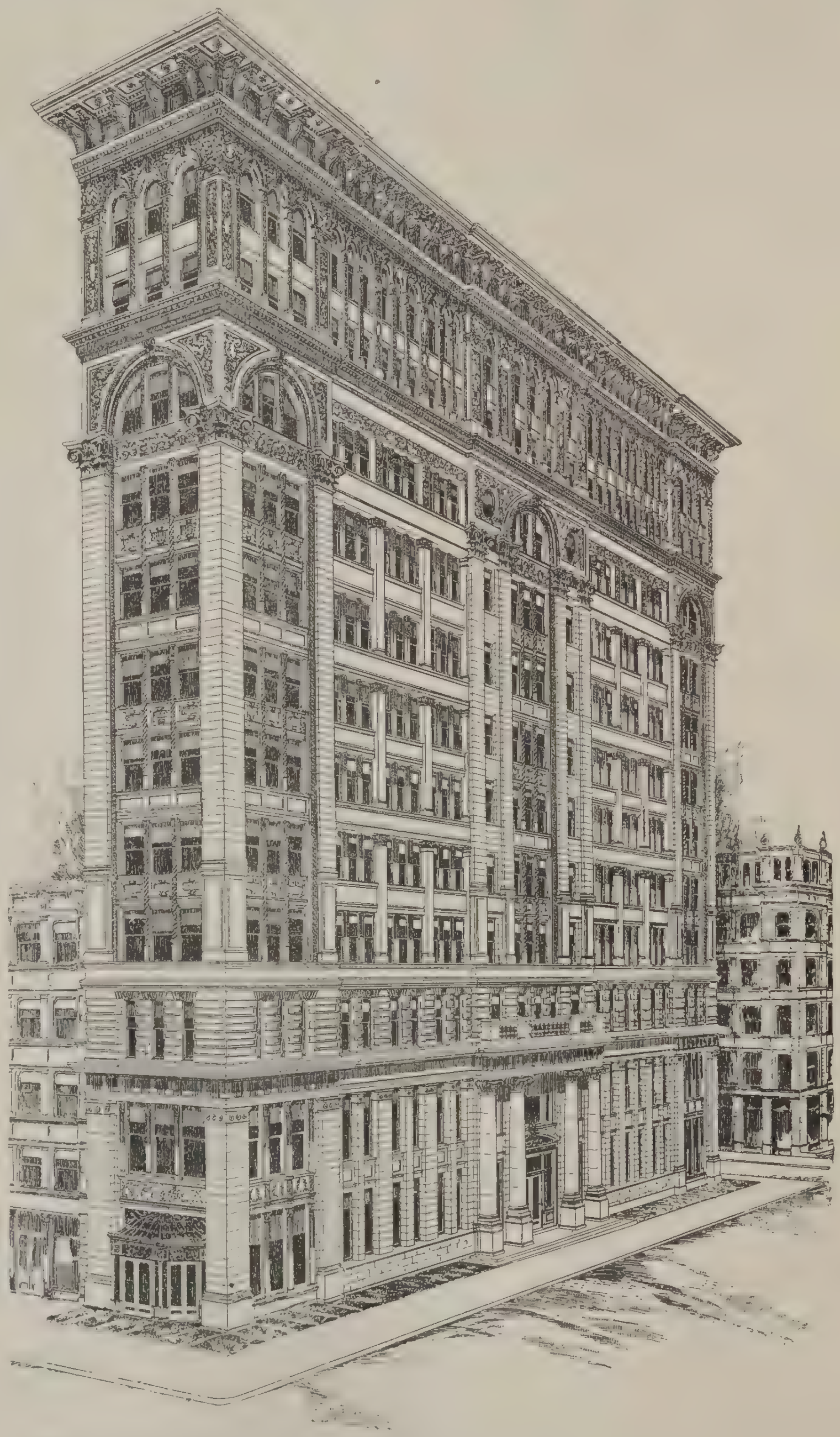
GRACE CHAPEL BUILDINGS, NEW YORK CITY.
Barney & Chapman, Architects.
250,000 gray bricks used in these buildings were furnished by the Eastern Hydraulic-Press Brick Co.

three stories and basement. Brownstone, brick, and terra-cotta. H. W. Jones, architect.

A. M. Fish is building a 40 by 60 ft. three-story residence on "Lowry Hill," to have ten rooms. Will be faced with "Kelley" cream brick, made by Northern Hydraulic-Press Brick Company. Cost, $10,000. Orff & Joralemon, architects.

For a special subject this month I have chosen the Hugh Harrison Wholesale Building, a fine example of business architecture, not surpassed in the Northwest. (See plate 61.) A six-story and basement building with a plinth course of St. Cloud granite. Body of the building is faced with a new Roman mottled manganese brick, of buff tone, furnished by Northern Hydraulic-Press Brick Company. The window jambs and quoins are treated with a darker brick of same make. The building has a composition roof and a cornice of copper and brick. The interior is of mill construction, structured iron furnished by Gillette-Herzog Company, of Minneapolis. Has three crane elevators, Wolff's sanitary appliances, and Porter Bros.' steam heating apparatus.

COLUMBUS, O.— There seems to be a marked revival in building in the city, and many things indicate a good fall and a busy spring. Two new business blocks are under way, and others are being planned, while several small churches and residences are also in process of erection. One of the very worst and most discouraging signs of the times — in building — is the large number of dilapidated old fire-trap structures which are being rehabilitated (?) with paper, paint, etc. During the past season no less than a dozen structures of this description have been treated with new fronts of galvanized iron and stamped metal,— made up into forms to imitate classic details,— with "*bran new*" elevators, etc., etc., until the wayfaring man would imagine we had several new modern structures,— judging from the outward appearance. Some new work, however, is being done.



OFFICE BUILDING, BROADWAY, BROOME, AND MERCER STS., NEW YORK CITY.
John T. Williams, Architect and Owner.
Face Brick furnished by the Sayre & Fisher Co.

Architect Elliot reports plans completed for a five-story hotel or apartment building to be erected for Mr. Frank Powell. The building will be fire-proof, built of brick, terra-cotta, and steel. The face brick will be Roman pressed brick. The building will cost $125,000.

Architects Yost & Packard report plans out for a German church, to be built of brick, with stone trimmings. Cost, $6,000.

Architect Terral reports a five-story factory, 190 ft. by 72 ft., to be built of brick.

ROCHESTER.— The fall season promises little in building circles this year. There is just enough work to keep things moving and that is all.

Messrs. J. G. & J. W. Cutler have let contracts for the erection of a three-story building, to front on East Main Street, East Avenue, and Belmont Park. It will be a continuation of the building erected by them a few months ago, and will be of a dark gray brick, furnished by the New York Hydraulic-Press Brick Company. This building will eventually be seven stories high.

The building for the Liberty Improvement Company will soon be completed, and it is expected to be ready for tenants by the middle of November. It is built of pressed brick and terra-cotta. The pressed brick was furnished by the New York Hydraulic-Press Brick Company, and the terra-cotta by Perth Amboy Terra-cotta Company. Architect, J. Foster Warner.

Mr. George T. Otis, architect, is having plans figured for a manufacturing building to be built for Mr. J. C. Lighthouse, on Mansion Street. The same architect is preparing plans for the First Presbyterian Church, at Mendon. It will be English Gothic in style, and will cost about $10,000.

This has been a busy year for the architects who make a specialty of manufacturing buildings. Messrs. Charles S. and Harvey Ellis have erected six of these, four of which are built of pressed brick and terra-cotta, and two are fire-proof. The average height is six stories. Messrs. Ellis are also preparing plans for two other buildings, which will soon be announced.

DETROIT. — Each succeeding week sees increased activity in the western and southwestern suburbs of Detroit, and visitors to the city and others who desire to find where the industrial pulse of the metropolis beats rapidly and strong must visit the section located near the Rouge River.

Any attempt to describe the busy scenes must necessarily fall short of the actuality. Beginning half a mile north of Wyandotte, several hundred men have been at work all the past week, constructing the switches from the Michigan Central Railroad to the new plant of J. B. Ford & Company, and last week the siding was filled with cars, loaded with material for the buildings that will nearly cover the 125 acres.

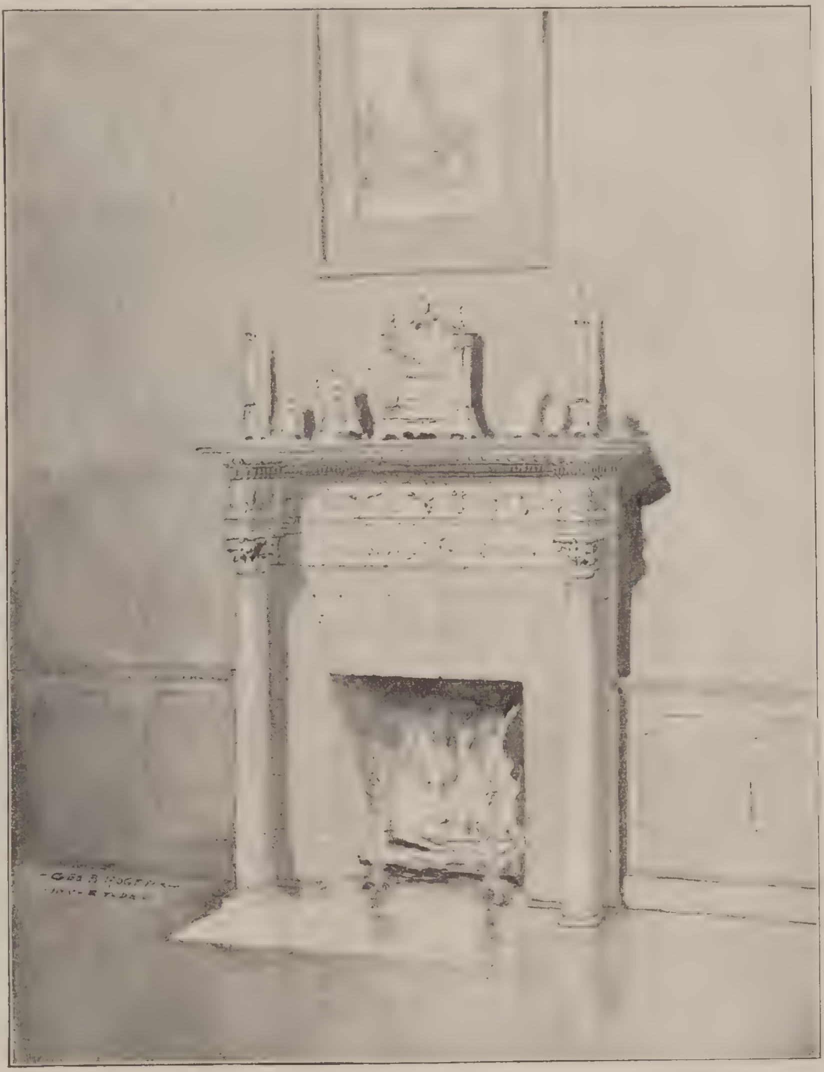
Coming nearer to Detroit, one finds the mills running night and day on orders for material for the many new buildings contemplated and in course of construction all along the line of the Detroit & Wyandotte Electric Road.

A mile east, ground is being broken for a $1,000,000 factory by Canadian capitalists.

Next comes the great Solvay Process Company, which is hard at work on the old exposition grounds, preparing for what will unquestionably be the largest soda ash factory in the world.

The State Board of Education have adopted plans by Malcomson & Higginbotham for the new State Training School, for which the last legislature appropriated $25,000.

Plans are out for a magnificent apartment house and family hotel, which will shortly be built in Detroit, if satisfactory arrangements can be made for a site. The building is estimated to cost $150,000.



MANTEL DESIGNED BY GEORGE B. ROGERS.
Executed in Faience by the Atwood Faience Company.

HENDRICKS' *Architects' and Builders' Guide* has made its annual appearance. It is a volume of over 800 pages, containing the names and addresses of over 200,000 architects, builders, and manufacturers of all materials kindred to building, given in alphabetical order. New York, S. E. Hendricks Co. Price, $5.00.

The Architects' Directory for 1895–96, by the same concern, containing a list of the architects in the United States and Canada, classified by States and towns, giving the architectural associations to which they belong, has, the publisher states, been prepared with great care to secure accuracy of both name and location. Bound in red boards, gilt title, 16mo, price, $1.00.

THE Competition drawings are now being exhibited at the Chicago Architectural Club. Manufacturers should encourage a large attendance at these exhibits as they are good arguments for the use of brick and terra-cotta in city houses.

MR. WM. CONNORS, Troy, N. Y., the well-known manufacturer of "American Seal" Mortar, Stains, and Roofing Cement, authorizes us to announce a competition for the best design for an advertisement to be used in THE BRICKBUILDER. The wording which is to be incorporated in the design may be found in Mr. Connor's advertisement for this month on page xxiv.

The drawings must be made in line with black ink on sheets cut to the uniform size of 4 by 11 ins. Each drawing must be marked with a motto or cipher, and a sealed envelope similarly marked, containing the full name and address of the designer, must accompany the drawings. These envelopes will not be opened until after the award is made. The designs for which prizes are awarded will become the property of Mr. Connors.

For the best design, there is offered a first prize of $25, a second prize of $15, and a third prize of $10.

The prizes will be awarded by a jury of three gentlemen competent to judge of this class of work.

Drawings must be delivered flat, express or postage prepaid, at the office of THE BRICKBUILDER, not later than October 1.

THE accompanying illustration is of a mantel executed in faience by the Atwood Faience Company, of Hartford, and is taken from the very attractive and artistically gotten up catalogue which they have recently issued.

A very pretty bit of work recently done by this company is the name and date for the new Odd Fellows Hall, Waterbury, Conn.; Wilfred E. Griggs, architect. The face of the letters is enameled in a golden yellow, and the background in a darker color, to harmonize with the Pompeian terra-cotta of which the building is built.

THE Pioneer Fire-proof Construction Company, of Chicago, are getting out a 17 ft. arch which will be used in the Occidental Building now being erected in that city. This, we think, is the largest arch that has ever been made, and will be fully illustrated and described in a later number.

To see the list of buildings for which this company has furnished fire-proofing during the past year one would not think that building operations had been particularly quiet in the West. Some of the more important contracts taken were for the Fisher, Occidental, and Reyerson buildings, Kenwood, Straus, and Irving apartments, and Drovers' Bank, Chicago; St. Joseph's and St. Luke's Hospitals, St. Paul; Lonsdale office building, Duluth; New City Hall, Davenport, Iowa; Lincoln Telephone Building, Lincoln, Neb.; Shawnee County Court House, Topeka, Kan.; Hutchings and Sealy office buildings, Galveston, Texas.

THE new catalogue of the Sayre & Fisher Co. is a most attractive and complete volume relating to the manufacture and use of all kinds of building brick.

Its contents are of a very interesting character, comprising a large number of fine half-tone illustrations of prominent buildings which have recently been erected in New York City and elsewhere; also, a most interesting list of well-known modern buildings (giving the names of architects of same) which have been erected in many of the large cities. The color plate of fancy "fronts" and enameled bricks are exceedingly well done, and gives one a very good idea of the texture as well as the color of the bricks. A large variety of molded brick is shown with sizes of same.

Not the least interesting feature is the illustration of brick mantels, all the dimensions of which are printed below the illustrations.

In compiling this catalogue no expense or pains have been spared, and it is a worthy representative of this well and favorably known concern.

THE regular six months' winter course of the Academy of Architecture and Building, St. Louis, Henry Maack, principal, begins October 1. This is its tenth school year. The course of study offered is an excellent one, and can be mastered in one year by those students who have received a thorough grammar school education, ready for high school, and have besides a few years' experience in a building trade or in an architect's office, and study with absolute application. For all others the time must be liberally extended. According to ability, it will take them from one to six months longer to finish the full course.

A NEW carton or wrapper for protecting enameled brick in transit has been invented and introduced by the Thompson & Norris Co., of Brooklyn, N. Y. They seem to fill a long-felt want, and are being used to a great extent by the manufacturers of glazed and ornamental brick.

OFFICE
KULAGE MACHINE WORKS,
ST. LOUIS, MO.

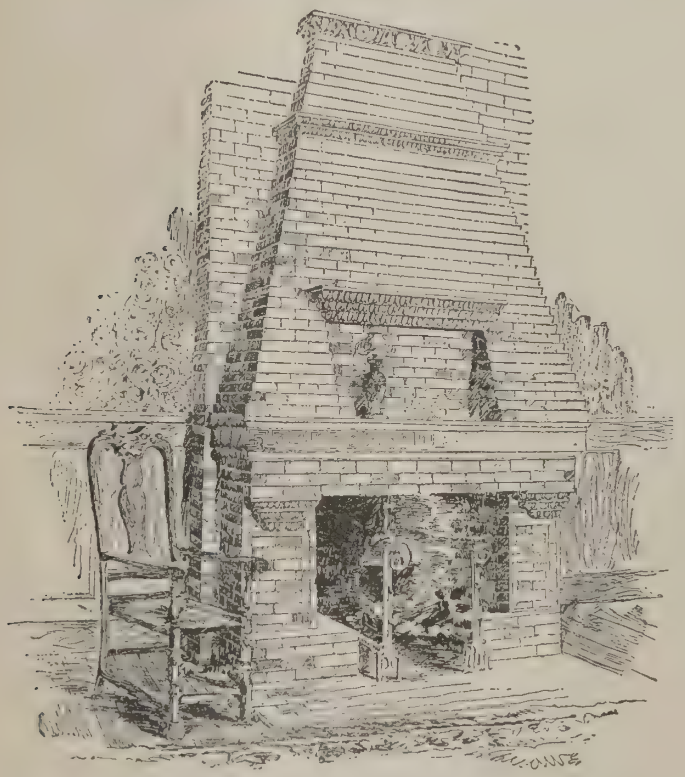
Messrs. BRICKMAKERS,
United States and Canada.

Gentlemen:—We would herewith call your attention to the following, viz.:

We manufacture the Kulage Brick Press, which is the celebrated "Triumph" Dry Clay Press Brick Machine. We guarantee this press to be without an equal. The "Triumph" has a capacity up to 35,000 plain or shaped pressed bricks in ten hours, has four distinct or quadruple pressures, has solved the problem of a twin, or top and bottom pressure, without the center seam streak or granulation; is simpler, stronger, and built upon better scientific principles than any other dry clay brick press on the market. The price of a "Triumph" press is $5,500, which entire amount may be saved or gained during the first year of operation in the superior quality of its product, capacity, and economy of operation, and as compared with that of other presses.

We construct and equip brick plants of any capacity complete, and in this connection would say that we manufacture the "Triumph" Loading Machine—also a money maker for the brickmaker. This machine gathers the previously plowed and dried clay from the field and loads same into carts or wagons. With two or three horses and one driver, its capacity is the gathering and loading of as much clay as twenty men with shovels would do. The benefit of one machine to a certain brick concern during this season is calculated to be over $4,000.

We like to correspond with progressive brickmakers. Yours respectfully,
KULAGE MACHINE WORKS,
North Broadway and College Ave., St. Louis, Mo.



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No. 4 LIBERTY SQUARE, BOSTON, MASS.

VOLUME IIII
OCT. 1895
NO. 10

THE BRICKBUILDER

OFFICE
85
WATER
STREET
BOSTON

THE BRICKBUILDER.

AN ILLUSTRATED MONTHLY DEVOTED TO THE ADVANCEMENT OF ARCHITECTURE IN MATERIALS OF CLAY.

PUBLISHED BY

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THE MANUFACTURER'S SIDE.

EDITORS OF THE BRICKBUILDER: —

Gentlemen, — Some notable articles have recently appeared in THE BRICKBUILDER on the subject of colored bricks. Written apparently by architects of high standing, they indicate an interest in this subject among the leaders of the profession which is very encouraging, and which is likely to bring about some interesting results. One of the most noticeable things about these articles is the unanimity with which they emphasize the importance of a refined taste in the use of colored bricks. "The loud and vulgar effects," which are, indeed, too common, are scathingly rebuked, and, while we cannot wonder at the expression of contempt for these, we must remember that every good thing has its vulgar imitators, whose bungling attempts to reach the (to them) unattainable only emphasize the beauties which rest upon the heights above them. "There is always room at the top," and the truly ambitious and able architect may rest assured that if he reaches the summit his efforts will be appreciated. Another opinion expressed in these articles is that the rough surface brick is preferable to the smooth where artistic effects are sought. This question of surface and texture is one of the most interesting connected with the manufacture and use of brick. Twenty-five years ago very few pressed brick were produced, the common rough red being the standard.

Among the first to introduce a brick of superior workmanship was the Peerless Brick Company, of Philadelphia. Their molded and pressed bricks soon became famous for fine fronts, and were shipped all over the country. The demand was so great that the Peerless Company could not meet it, and other factories were established, and pressed red bricks came into general use. The bricks were of good workmanship and were made by the "soft-mud" or "water-tempered" process. They were pressed in hand presses. Then came the invention of power presses, and, as these were improved, it was discovered that dry clay, when subjected to the enormous pressure obtainable by these presses, could be formed into bricks of most perfect outline, which could be passed direct from the press to the kiln. Mechanically, the dry pressed bricks are perfection. Being made of finely ground clay as it comes from the bank, without the water-tempering process, the particles composing the bricks are driven together by the enormous pressure of the steam press, forming sharp, clear-cut edges, as perfect as if carved in wood or cast in metal. With this perfection of form, however, naturally goes a perfection or imperfection, as the opinion may be, of surface and texture. No discussion is intended here of the comparative merits of the water-tempered and dry pressed bricks, and no reflection is intended upon the latter when I say that they are too smooth in appearance to suit the taste of such architects as the writers in THE BRICKBUILDER before mentioned. It is fortunate that all tastes are not alike, or we should not have that variety which is so truly the "spice of life."

But there are extremes in both directions; the "rain washed," the "pimpley," and the "twisted" bricks are the extremes in the direction of rough surfaces.

While such, doubtless, have their uses, they are quite liable to be misused; for instance, a misuse of rough bricks has been made in the Boston Public Library, where, in one of the reading-rooms, the roughest kind of red bricks, devoid of merit, even in the direction of color, are exposed to view. One cannot help thinking what a fine effect could have been obtained by the use of water-tempered, hard-burned brick, of a soft russet color. In connection with this subject of interior brick, I note the remark of one of the writers, that it would prove a great boon if large-sized bricks or blocks of the present fine and numerous colors could be produced for the interior of churches. I would like to remark right here that such bricks and blocks can be produced, and the time is at hand when they will be, in such variety and beauty of color, such excellent workmanship, and, at the same time, at such moderate cost that their use, not only in churches, but in other public buildings, will become very extensive.

The above is my prophecy; "watch out" and see how soon it will be realized. But, as to color, there is one point of considerable importance which I note has not been touched upon by THE BRICKBUILDER writers, namely, the question of the color of mortar used with colored bricks. The importance of this factor cannot be over-estimated.

You may take the same bricks, and build one front with red mortar, another with black, and another with white, and at a distance of, say, 200 yards or more a novice would most surely declare that the bricks were of a different color. There is a public building now being erected in Rhode Island, where the architect had planned to use different shades of bricks in the different stories, in order to obtain a certain color effect, but has now decided to simply use different colored mortar with the same bricks. The result will be watched with interest.

The manufacture of high-class, architectural clay products, although it has received a great impetus within the past fifteen to twenty years, is susceptible of still more remarkable development. Men of brains, of educated and well-trained brains, are giving it the best effort of their lives. Architects of high standing and ability are devoting much personal attention and study to it, and the results are likely to be surprising, especially in the direction of machine-made clay products of great range of form and color, and of very moderate cost.

A few days ago two builders were discussing this matter, and they were both agreed that a few years ago they were not troubled with this color question; a brick house was a *red* brick house, as a matter of course, but now, they said, "we must spend days in studying this question, comparing this color with that, and the more we study it, the more puzzled we are." This is doubtless true, but it is also true (in spite of its misuse) that the introduction of color into our architectural clay products has wonderfully beautified the architectural features of our cities, and has opened new avenues of attainment to our aspiring architects.

GEO. M. FISKE.

WITH the prospect before the people of Boston of having to use for many years the subway now in progress of construction, we feel it is not amiss to urge emphatically the use of such materials in the finishing construction of the same as shall materially add to its beauty while contributing to its structural qualities. We believe that, in addition to simply meeting the absolute requirements of a mere tunnel for the purpose of facilitating transportation, the subway should be light, bright, well ventilated, and attractive. As the motive power will be electricity, there is not the question of smoke and gas with which to contend; thus, the interior of the tunnel once lined with a proper material, having the qualities named above, there is practically nothing which would mar its beauties by dirt and stain.

In seeking the material which shall combine these elements of being light, bright, and attractive we naturally turn to enameled bricks. They certainly have all these qualities and others as well, being tough under conditions of strain and pressure, retaining their surface against the action of heat and cold, and holding their brightness unchanged through the lapse of time. They are impervious to moisture, easily manipulated, can always be duplicated, and when their worth is compared to their cost they are not expensive.

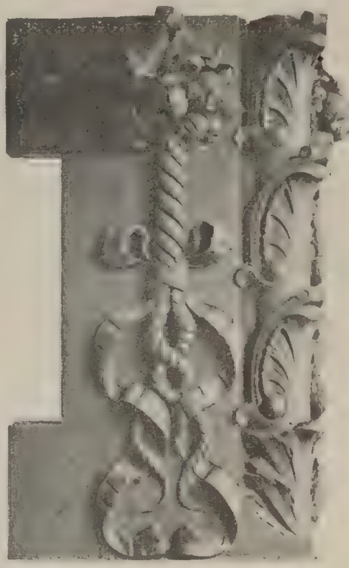
It would seem from their growing popularity that their practicability in this capacity *is* well established. A handsome example of subway for pedestrians so finished may be seen at Allston, Mass., in a passageway which extends under the Boston & Albany Railroad tracks. Here a combination of white enameled bricks with those of a chocolate-brown color for bordering is used.

We do not believe it is the aim of the commission to give us simply a trench as a means of rapid transit. On the contrary, our subway should combine utility and beauty as far as practicable, and when decision is finally made as to the interior finish enameled bricks should be the choice.

We cannot at this time give the names of the gentlemen who will act as judges for the New York Architectural Terra-Cotta Company's Competition, as two of the gentlemen desired are at present in St. Louis, attending the convention; we shall, however, be able to announce the prize-winners, together with the judges' report, in the November number.

The drawings submitted in the City House Competition, which were prepared for exhibiting in the different architectural clubs of the country, have scored a decided hit in those cities where they have been shown. They acted as THE BRICKBUILDER'S representative at the St. Louis Convention of the American Institute of Architects.

OUR ILLUSTRATED ADVERTISEMENTS.



THE subject of this month's illustration in the advertisement of the Hydraulic-Press Brick Company (see page xix), is the church of Santa Maria, in Transtevere, Rome. This church was built in 1139, portions of which have been restored at various epochs since.

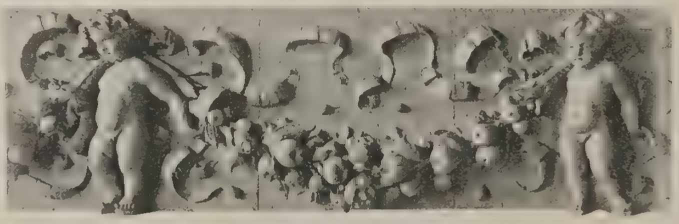
On page xviii will be found an illustration of "The Bolkenhayen," on Fifth Avenue and 58th Street, New York. All above the first story is executed in brick and white terra-cotta, the latter having been supplied by the New York Architectural Terra-Cotta Company from designs by Mr. Alfred Zucker.

The adjoining plates show a portion of the quoins used up the main angles of the building and the motif in frieze over the triple windows on Fifth Avenue front. The diaper work on sixth story is laid up in small blocks, with a simple ornament in relief on face of each block, giving an effective variation to the wall surface.

The illustration in the advertisement of the Celadon Terra-Cotta Company, Charles T. Harris Lessee (see page vi), is the residence of the late Geo. H. Babcock, at Plainfield, N. J.

This design was treated in a very odd and picturesque manner. The exterior walls are built of selected, over-burned brick and accidents of terra-cotta and Philadelphia pressed brick, laid up at random, without regard to uniformity and with noses protruding. The roof is covered with a combination of the Celadon Terra-Cotta Company's Rhinocerous and Gothic Tiling, which produces an effect in harmony with the design. Mr. Babcock was president of the company and the inventor of these tiles, which are becoming favorably known among the prominent architects of this country.

The Clinton Metallic Paint Company have a fine half-tone illustration of the 71st Regiment Armory, 34th Street and Park Avenue, New York City, in their advertisement (see page xxiv). The large granite blocks used in the construction of this building were laid up in their Clinton Hematite Red Mortar Color.



The following gentlemen have consented to act as judges for the William Connors Competition: Messrs. R. Clipston Sturgis, Bertram G. Goodhue, and David A. Gregg. The prize-winners and report of the judges will be published in our November number.

The Sixth Annual Convention of the National Association of Commissioners and Inspectors of Buildings was held at Baltimore, October 15, 16, and 17. Among the subjects considered and upon which papers were submitted were, "How to Prevent the Spreading of Fires in Apartment Buildings and Flats," "Safety of Floors in Business and Public Buildings," "Probable Safety of Mill Construction as Compared with Brick, and Stone, and Ordinary Wood Buildings," "Strains as Applied to Wood, Steel, and Iron Construction," "Egress — School Buildings, Churches, Hospitals, Theaters, Factories, and Public Halls."

TERRA-COTTA TREASURES.

BARON ROTHSCHILD has purchased the beautiful collection of antique art treasures which has lately been discovered at Bosco Reale, and has presented them to the Louvre, where they will be on view in October next. The collection is formed of about forty pieces, which have been buried for more than eighteen centuries under the cinders and lava of Vesuvius, and have, therefore, of course, been much damaged. Bosco Reale is situated between Pompeii and Vesuvius, and was destroyed during the great eruption of Vesuvius, A. D. 79. Some owners of property there of the name of De Prisco, in making some excavations a short time ago, discovered the villa of a rich Roman patrician, and in this villa they found silver ornaments, glass candelabra, and amforæ. There are also lamps and "biberons" in terra-cotta, on the latter being beautiful reliefs. The most important object of the collection, and that which is at the same time the best preserved, is a large patera, 25 centimeters in diameter, which has a finely executed bust of Africa in relievo in the center in the form of a young girl, lightly clad, and with the proboscis and tusks of an elephant on her head. There are also some beautiful vases and tazze. It is said that it will require three months before the entire collection can be properly restored. — *British Clay Worker.*

GLAZED BRICK MAKING.

A NOTE OF WARNING.

THE improvement in trade, which has caused the demand for glazed and enameled bricks to increase very rapidly, has once again drawn the attention of brickmakers all over the country to this class of work, and it is well to issue a note of warning to all those who fail to see why they should not engage in this apparently very remunerative branch of the trade. We would first simply advise our readers not to be misled by laboratory experiments, or to think that because they may have succeeded, after a course of experiments, in producing a small piece of enameled ware that they have solved the whole question as far as relates to their particular clay. Unfortunately, there are, at the present time, a number of so-called glazed brick experts who take upon themselves a roving commission, and very often succeed in getting hold of an enterprising brickmaker who, by promises of what they can do, and even by samples produced in some mysterious manner in a back building at the works, is led on to spend time and money in following up this "will-o'-the-wisp." In a great many cases the sole object is to get a position in the works at a good salary until that position becomes slightly uncomfortable. Needless to remark, under these circumstances the experiments are found to take much more time than was at first anticipated, and we could cite cases where one and even two years have been frittered away, the result achieved being practically of no use as far as actual business is concerned, to say nothing of extensive monetary loss. Given a small quantity of clay, it is quite easy to treat it in such a manner as to produce a glazed face, apparently of good quality; but it is an entirely different matter to make glazed bricks in quantities and fit for the market. This is quite apparent to all who have in any way studied the subject. Take, for instance, our largest manufacturers, and ask them what is their experience. Is it not that thousands of pounds had to be sunk to accomplish the required result, even after splendid examples had been produced in the laboratory or in an experimental way? We do not wish here to go into the complex question of glazing, but would simply urge upon all who are contemplating a step in this direction that too much care cannot be taken, and that appearances are often most deceptive. — *British Clay Worker.*

"VITRIFIED PAVING BRICK" is the title of a valuable little book just published by T. A. Randall & Co., Indianapolis, from the pen of Prof. H. A. Wheeler, who has made a specialty of the study of clays. It is a very timely publication, in view of the active discussion on the subject of good roads, especially as it is devoted to a class of pavements that seems to have a great future in this country. Price, $1.

BRICK AND MARBLE IN THE MIDDLE AGES.

G. EDMUND STREET.

CHAPTER VIII. — *Continued.*

I HAVE already shown that there are repetitions of many of the subjects, but it is equally worth notice that the foliage which forms the framework for the subjects is also repeated. There are, I think, only four varieties in its arrangement. In the first the capitals are arranged very simply — in some cases rudely — with tufts of foliage or heads. The capitals numbered 2, 3, 6, 13, 16, 20, 23, 27, and 34 are examples of this. In the next, the foliage of the lower part grows up vertically, bending slightly out to support the sculptured subjects. These are generally the most graceful of all, and infinitely richer in effect than the first class. The capitals numbered 1, 7, 9, 12, 18, 24, 26, 28, 33, and 36 are examples of these. In the third class the foliage is generally marked by the same feeling, but it rises vertically to the angles and curls over under the subject; the nineteenth and twenty-fifth capitals are examples of this class. In the fourth class the foliage curves over downwards, both at the angles and under the subject. The neckings below the capitals are wrought on the shaft itself. They are sometimes molded, sometimes corded, and sometimes delicately carved with foliage; these last are by very much the more beautiful, and generally accompany the best wrought of the capitals, whilst the inferior capitals have, in all cases, the plainer necking.

The capitals in the upper arcade have not so much story as those below. They have generally a head on each side in the midst of foliage, and are square in plan, though the lower caps are octagonal — a few only have their names written over them; but on the ground story most of the capitals have, or have had, explanatory inscriptions. Some of the upper capitals close to the northwest angle are among the best. The curves of the foliage in the angles of the capitals are admirably wrought, and may be compared, to the damage of the latter, with some of the lower capitals in the sea-front. The upper range of capitals gradually deteriorates from the northwest angle as you go to the southeast. These last are really very bad, having rude gross carving of the human figure, and foliage feebly massed and treated; but the upper capital of the southwest angle, with the figures of the four winds, and the two or three capitals near it must be excepted from this remark, being superb in design and execution.

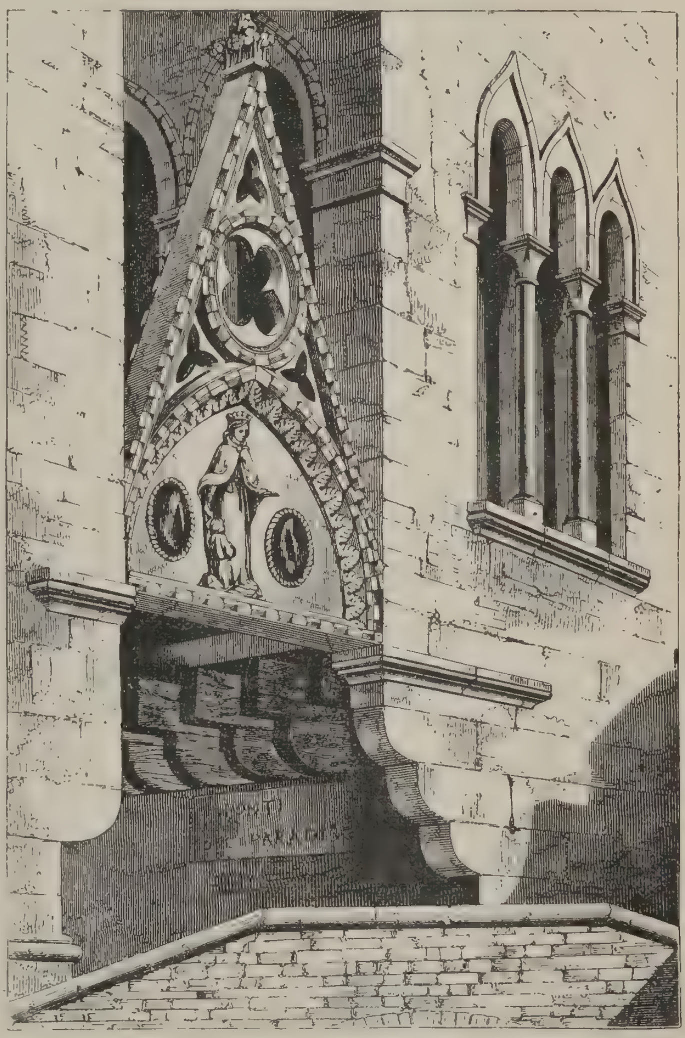
The remains of original work in the quadrangle are much less important. The arcade on the first floor remains, but none of its details are good, and on the east side it is a poor Renaissance copy of the other sides. The whole of the lower arcade has been destroyed or altered. But in the upper walls, which are faced with brick, some of the original windows remain; they are small, but of the same sort of detail and character as the larger windows in the outer walls.

The building has lost much by the gradual raising of the pavement. This is now about 20 ins. above the old base of the columns, and their proportions are so far altered for the worse. And it has lost immensely, also, by the destruction of the inlaid marble which once filled all the spandrels of the main arcade. Two panels only of these remain, and both in the sea-front. They are charmingly designed, enclosing circles which exactly touch the labels and strings.

Of the modern additions to this grand building I shall not say anything. They are not beautiful in themselves nor interesting by reason of their decorations, if I except those walls on which Tintoretto has lavished so much of his skill. The architects of the fourteenth and fifteenth centuries were artists in very deed, and it is with their work only that I can feel any real sympathy. Such, then, is the Ducal Palace, a building, certainly, in some respects, of almost unequaled beauty, but at the same time of unequal merit; its first and second stages quite perfect in their bold, nervous character and in the almost interminable succession of the same beautiful features in shaft, and arch, and tracery, forming, perhaps, one of the grandest proofs in the world of the exceeding value of perfect regularity and of a repetition of good features in architecture when it is possible to obtain it on a very large scale.

Leaving the piazzetta, and stepping into the gondola which has been waiting for us hard by, let us now go in search of other palaces; but let us not imagine that we are to see anything equal to the Ducal Palace. There is, it appears to me, a great gap between it and all other Venetian buildings; and yet all others seem to have been founded on it, or on the buildings out of which it grew. Their traceries, seldom absolutely alike, have still so much general similarity that at first one may well fancy that there is no variety at all; and, as I have before said, the general arrangement of their windows and doors is so nearly identical that this impression is the more likely to grow upon the mind.

We will not attempt to take the buildings as they come; but, rather, as we think of them, and to some extent in the order of their merit, let us note down a few of the glories of the domestic work of Venice. And first let us stop in this narrow canal, for we have by our side one of the most exquisite little pieces of detail in the whole city. It is an archway, simple and delicate in its proportions, lovely as it is simple, and appropriately placed hard by the bridge called "del Paradiso." I trust that my sketch is clear enough to show how pure and good the work is. The main points to be noted are the characteristic flatness of the details and the line of dentil-molding, which defines all the leading architectural features, originally invented for borders of incrustations at S. Mark's, and here, as everywhere in Venice, used for decoration afterwards. The incrusted circles of marble on each side of the figure give great life to the spandrel beneath the arch, and the windows seen behind show us a late example of the not unfrequent use of the semi-circular and ogee arches together in the same window.



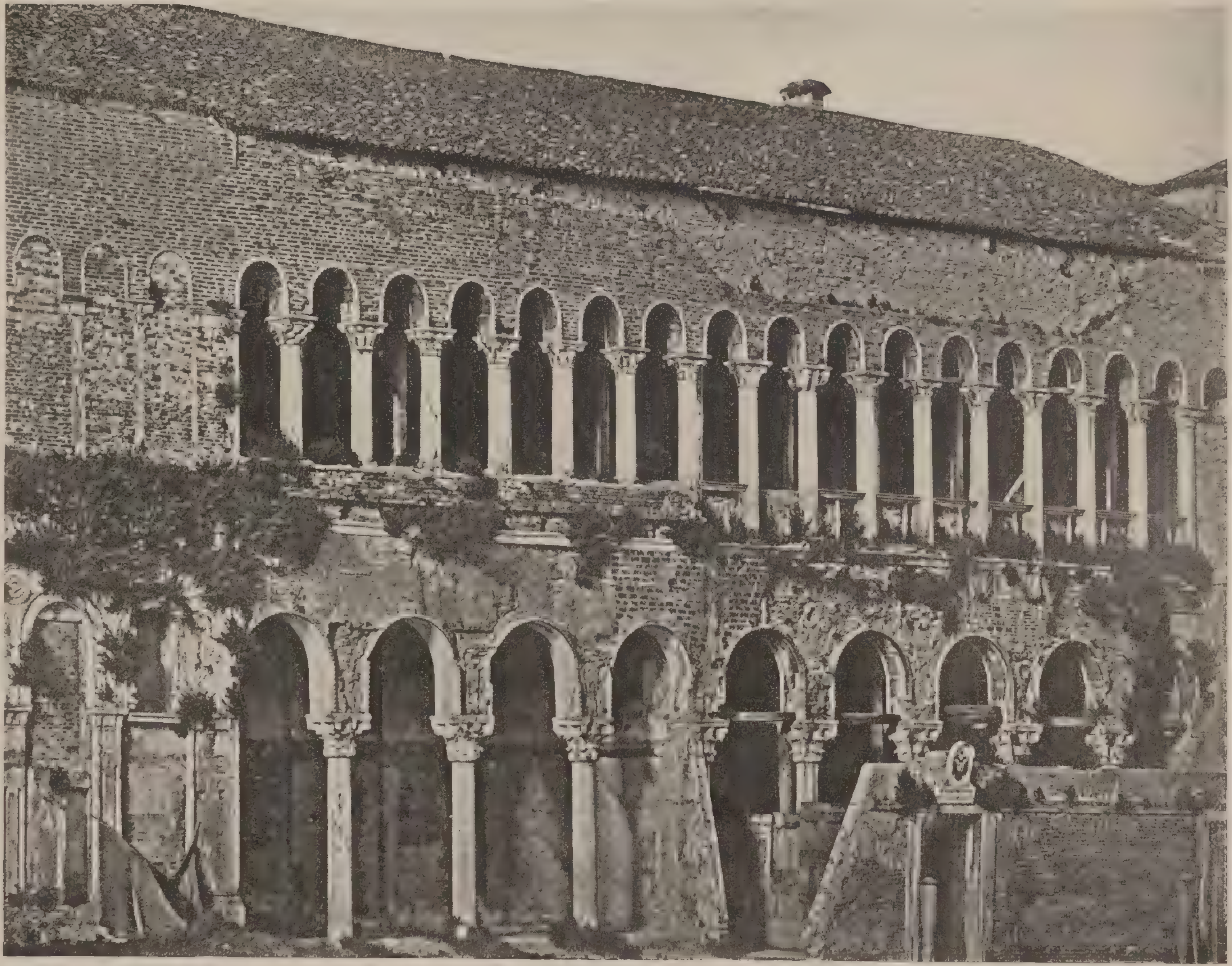
ARCHWAY, PONTE DEL PARADISO, VENICE.

Another precious fragment,— the Palazzo San. Giorgio, I believe,— is reached from the land side by passing under an arch somewhat similar to that on the Ponte del Paradiso. This arch is turned between the upper stories of two houses at the end of a *calle*, properly yclept "*dell' arco detto bon*," and is finished with a steep gable. Beyond it is seen a fragment of wall veneered with marble, with the upper part of an early two-light window, and two circular medallions, and above this a piece of wall veneered in diamonds of red and white marble, — so far as I know a unique example of such a treatment. The window-head is of that earliest form of ogee, a circle just turned up to a point in the center, which has so manifestly an Eastern origin, and which must not be confounded in date with our English ogee arches.

In another and rather desolate canal in the outskirts of the city, wider than usual, and with a footpath at the side of the water, instead of having the walls of the houses running down into it, and forming its boundary, is the Palazzo Cicogna, which I remember gratefully because it is one of the few exceptions to the general rule of regularity. The whole design of this building is very irregular; a detached shaft at one angle supports a portion of the house which overhangs and forms a sort of open passageway; to the right of this opening is a four-light shafted window, and then a plain wall pierced with two windows, each of a single ogee trefoiled light. The upper story has two single windows over the others, whilst over the larger windows and the passageway is a large window conspicuous from its size and the peculiarity of its tracery. It is of six lights, divided by very good shafts, and properly arched with pure and good trefoiled arches; above these and enclosed within the perpetual indented or billeted string-course is a complicated system of intersecting circles pierced at regular intervals with quaterfoils. The section of this upper part is very much thinner than that of the arches beneath. This window is in a most shaken and decayed state, and not likely, I fear, to be long preserved. The whole elevation is finished with a shallow cornice supported on corbels.

A doorway on the Ponte San Tomà is quite worthy of a visit. It has the usual square opening of reddish marble, and above this is a pointed arch of molded brick; the tympanum is filled in with a square carved center panel, and the ground beyond this with quartre-foils of brick or tile, very prettily disposed and quite deserving of illustration.

And now let us go back to the grand canal; we shall enter it by the side of the Palazzo Foscari, which, with two other contiguous palaces, occupies quite the post of honor at the bottom of the canal, and commands the whole view of its noble and ever-busy way to where the arch of the Rialto and another bend in the canal close in the view. We will go a few strokes only towards the Rialto, and then turn round to look at the palaces we have just passed. They certainly form a most magnificent group, and are in every way worthy of their conspicuous position. The palace at the junction of the two waters is that of the Foscari; the others belonged, I believe, to two of the Giustiniani family; and but a few yards up the canal, which runs by the side of the former, is one of the smaller remnants of Byzantine work already referred to. This group is so well known as scarcely to need any description; suffice it to say, therefore, that throughout these palaces the windows are shafted and the glass is fixed in wooden frames behind the stonework. This is beyond all doubt what we ought to do; it is the only sensible and rational mode of adapting the system of traceried and shafted windows for domestic purposes, and has here, as elsewhere, the prestige of ancient authority to recommend it to the consideration of those amongst us who will do nothing without it. I have enlarged on this point elsewhere, and will, therefore, say no



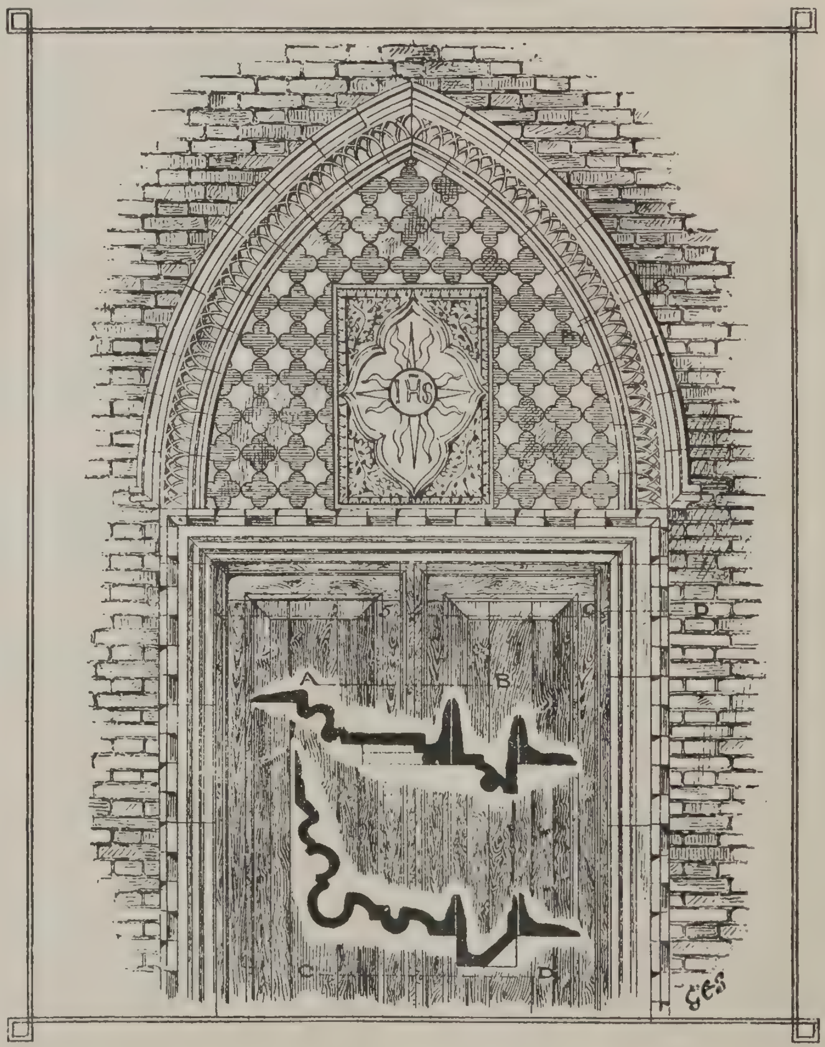
PALACE OF TURKISH AMBASSADORS.— BEFORE RESTORATION, VENICE, NOW THE CORRER MUSEUM OF VENETIAN ANTIQUITIES.

SUPPLEMENTARY ILLUSTRATION TO "BRICK AND MARBLE IN THE MIDDLE AGES."

more upon it now, save that in Venice such a thing as an English monial ordinarily is was never known. Windows were invariably shafted from the earliest period to the latest, and so far, invariably of the highest order, inasmuch as they admitted of the definite expression of the point at which the monial terminated and the arch commenced, and inasmuch, too, as the colored surface of the detached marble shaft must ever be far more lovely than the lines of tracery moldings carried down even to the sill.

The angle-shafts of the Palazzo Foscari have caps and bases in each stage of the building; those of the other palaces continue up without interruption.

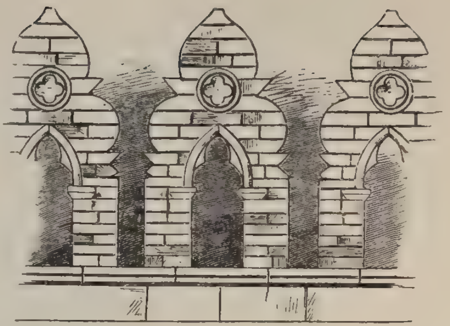
The date of the smaller palaces, and probably of the large one, also, is very early in the fifteenth century; and the latter had, in 1574, the honor of being the grandest palace that the Venetians could find in which to lodge Henry III. of France. They are all three very similar in their design. Their water-gates are pointed, and the windows in the water-stage small and unimportant. The second stage is more important, and has cusped ogee window-heads and balconies. The third stage is, however, the *piano nobile*, all the windows having deep traceried heads and large balconies. The fourth stage is very nearly like the first, save that, instead of balconies, there is a delicate balustrading between the shafts of the windows, which is very frequent in good Venetian work, and always very pretty in its effect. All the windows in these three palaces have ogee-heads, generally finished with carved finials, and enclosed within a square outline formed by the small dentiled molding, and giving what I have before had to refer to,— to some extent the effect of a panel with a window pierced in it, veneered on the front. The Foscari Palace is the only one of these three that has any string-courses. The arrangement of the windows, — large in the center and smaller at the sides,— is so nearly regular, and of a sort of two-and-two kind of uniformity, that one scarcely notices that, nevertheless, when internal arrangements make it necessary, a departure from this strict rule is allowed.



DOORWAY, PONTE SAN TOMA, VENICE.

The back entrance to the Foscari Palace is on the side canal. It is of some interest as retaining in a very perfect state an example of a very picturesque treatment in brick of the Venetian battlement. This consists of a series of piers finished with a steep gabled outline and pierced with trefoiled openings. A good example of this sort of battlement remains near the Fondaco de' Turchi, and deserves illustration. It is quite a Venetian invention, and errs on the side of quaintness.

In a small courtyard, desolate and dreary, reached after crossing the Ponte di Paglia and one or two other bridges on the Riva dei Schiavoni, is the Palazzo Badoer, a fourteenth century palace, the ogeed arches of the windows in which are more than usually good; whilst the beauty of the central window, enclosed within a square line of molding, within which the wall is incrusted with marble relieved by medallions, is very great. The structure of this, as of most Venetian palaces, is brick which has been frescoed; but it is now in a very lamentable state of decay. The balconies of the lower windows are clearly modern, but there is a trace of the original balustrade between the shafts of the windows in the second stage; and in front of the side-light to the upper window is a grill of iron work, taking the place of a balcony and composed of a combination of quaterfoils. The arrangement of the windows in this front is not absolutely regular, but still the center is very marked; and, though it is of early date, the true use of the arch nowhere appears. The usual [1] dog-tooth cornice finished the walls under the eaves. In the courtyard of this house are two of the wells which give so much character to all the courts in Venice. They appear generally to be of early date, and look, frequently, like the capitals of large columns, taken down and placed upon the ground. Those in front of the Palazzo Badoer are perhaps more like fonts.


BRICK BATTLEMENT, VENICE.

(*To be continued.*)

CLUB NEWS.

THE Chicago Architectural Club makes the following announcement regarding the classes for the coming year: —

Water Color, Hugh M. G. Garden; begins Sunday morning, October 20. Architecture, Geo. R. Dean; begins Tuesday evening, October 22. Pen and Ink, Chas. E. Birge; begins Thursday evening, October 24. Modeling, Richard W. Bock; begins Friday evening, October 25.

On Monday evening, October 21, Mr. Myron H. Hunt addressed the club on "The Impecunious Draughtsman Abroad."

THE first of Professor Marquand's articles on the work of Della Robia will appear in our December number. These articles be beautifully illustrated from original photographs.

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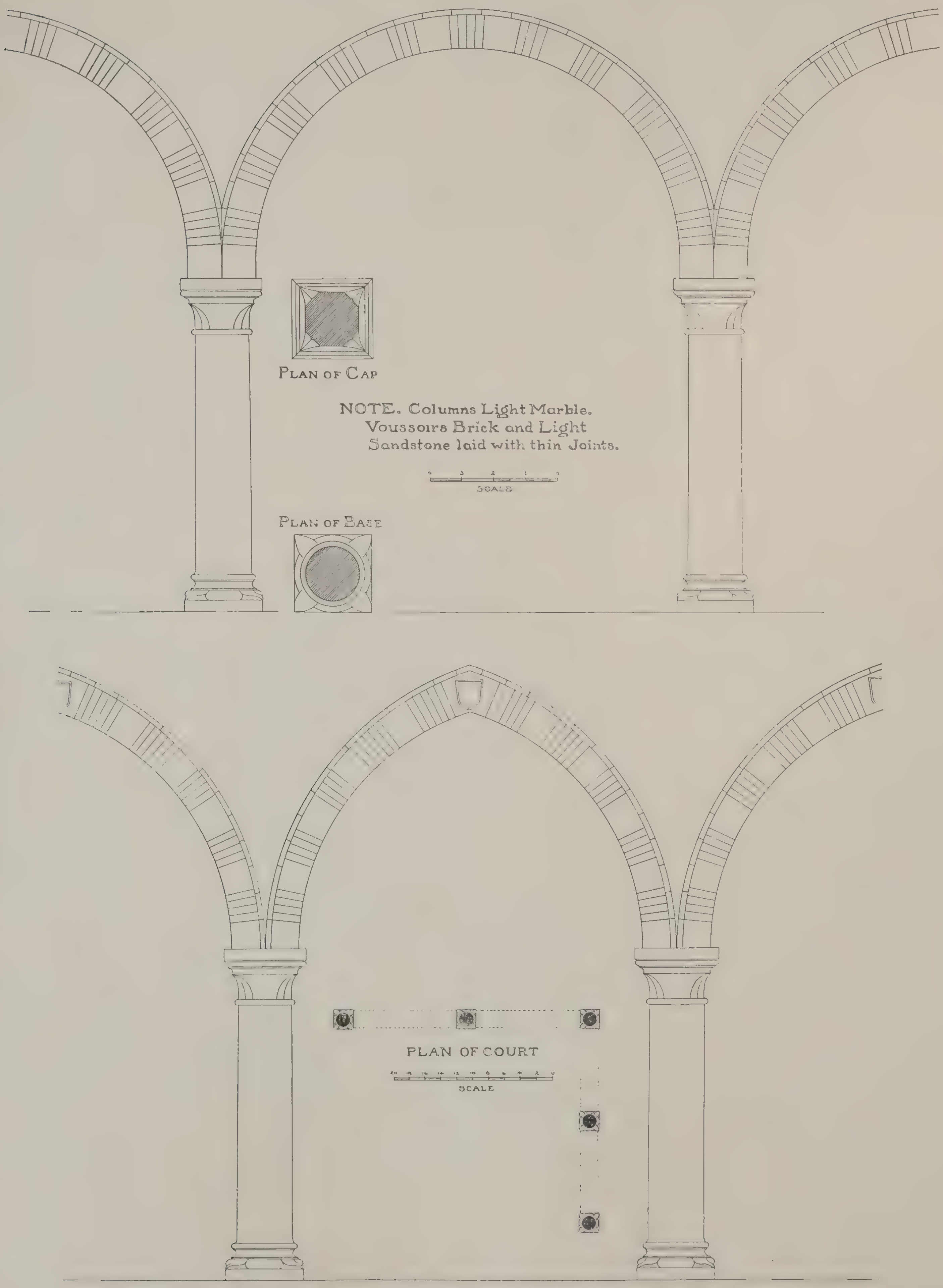
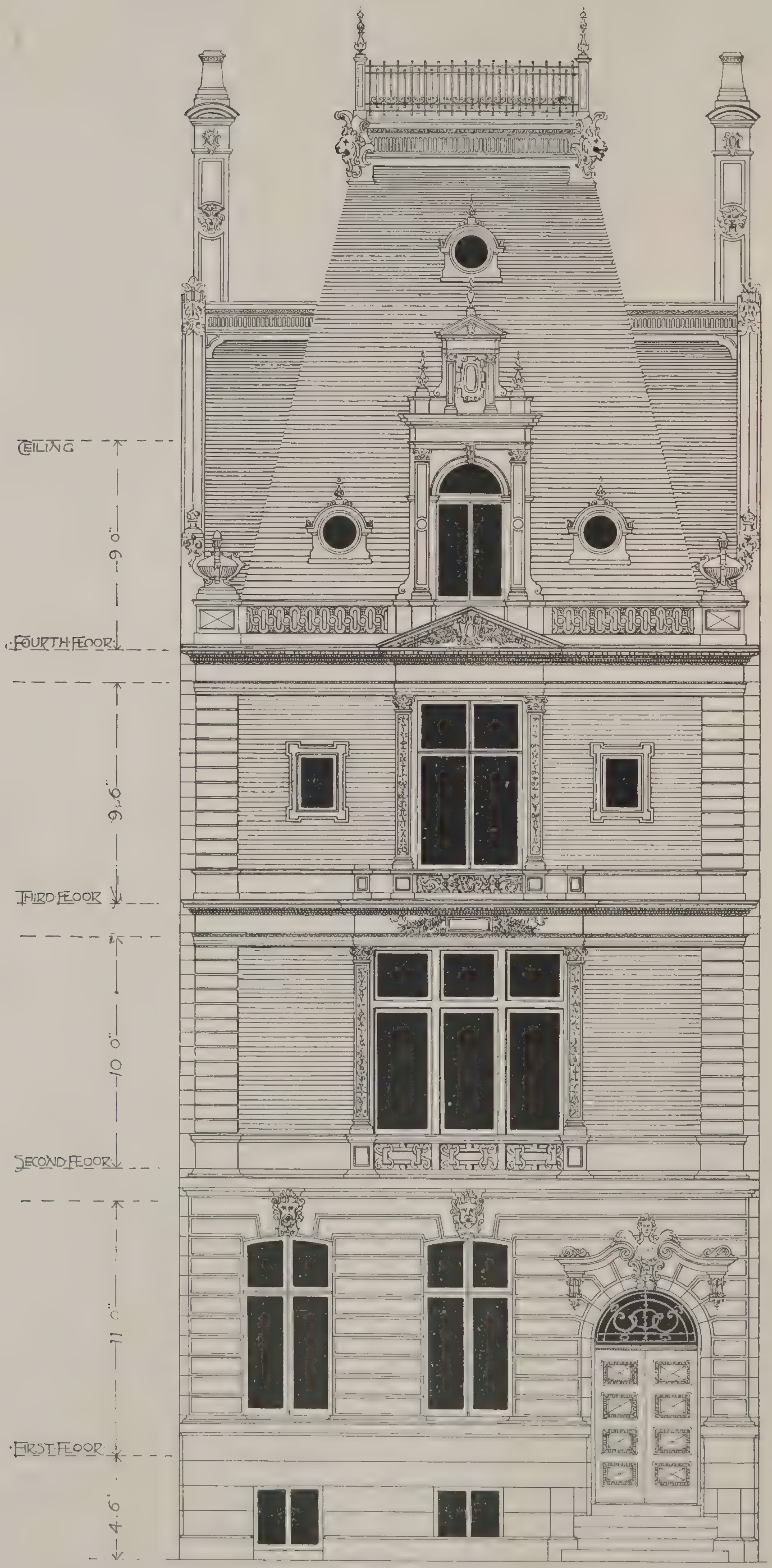
[1] I say "usual" because it is really quite curious to see how repeatedly either the dog-tooth or the nail-head is used in this position. The commonest eaves-cornice consists of a simple chamfered stone — the chamfer covered with dog-tooth — supported on molded corbels at short intervals.

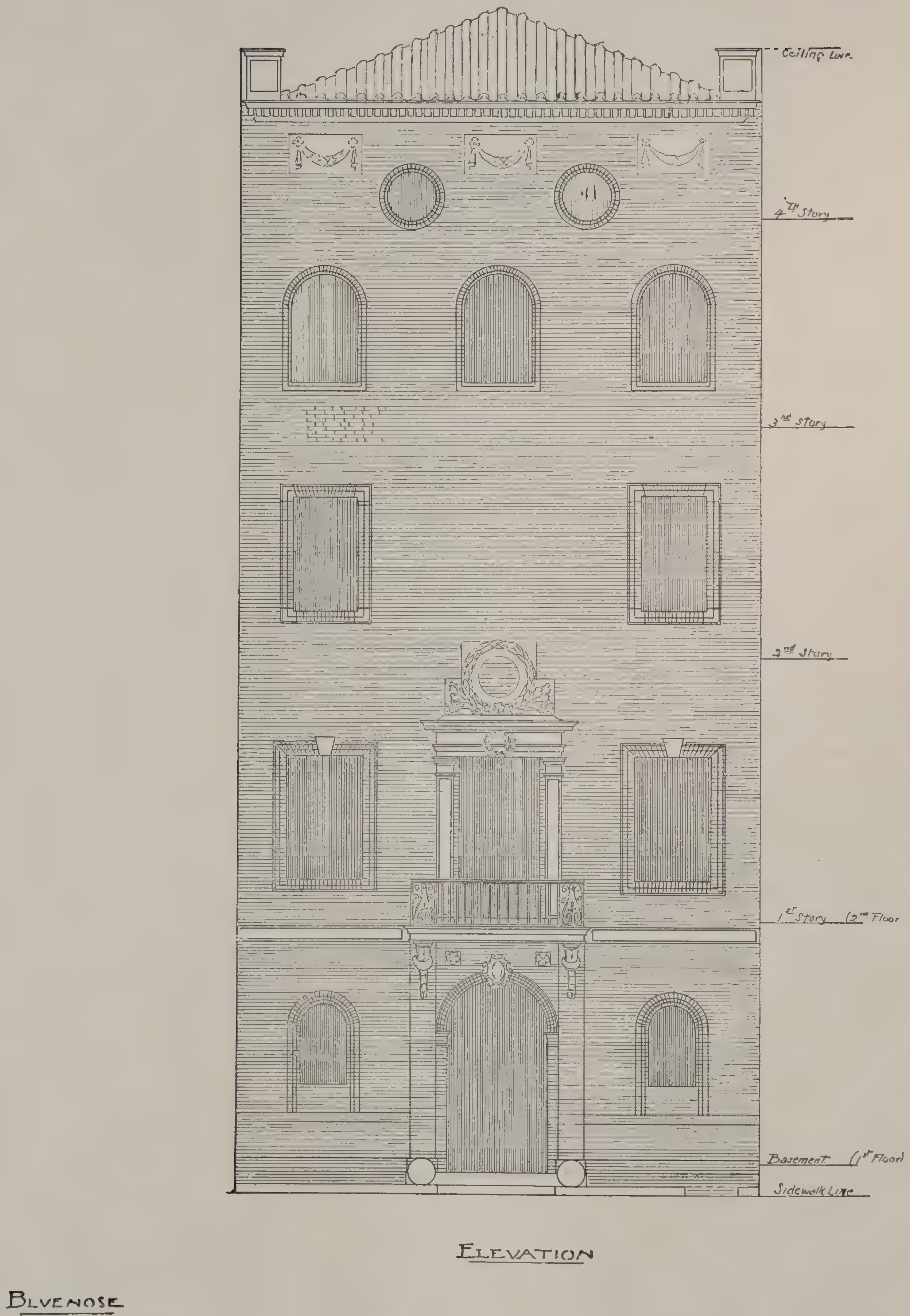


NOTE. Columns Light Marble.
Voussoirs Brick and Light
Sandstone laid with thin Joints.

MEASURED DRAWING OF ARCADE IN COURT OF HOUSE ON VIA ARCHE, ACALIGERE, VERONA.

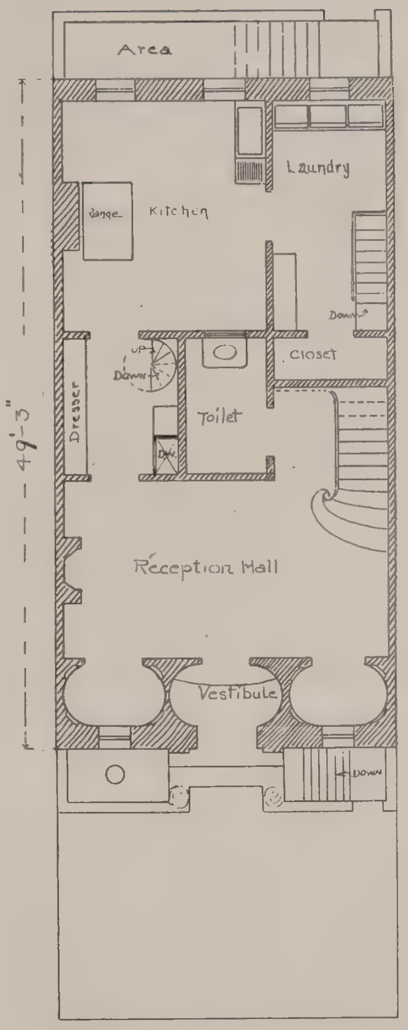


DESIGN SUBMITTED IN THE BRICKBUILDER COMPETITION
FOR A CITY HOUSE.

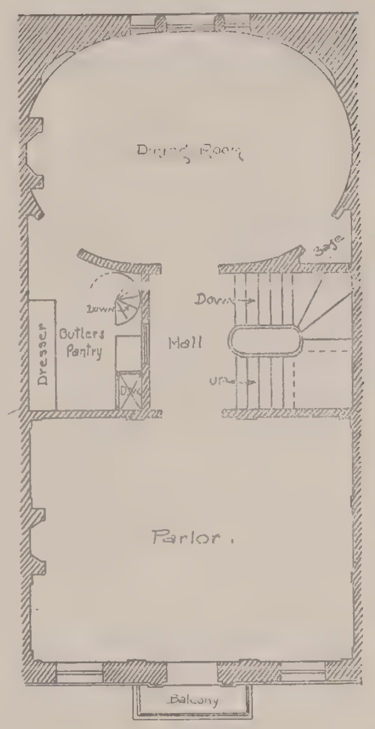


THE BRICKBUILDER COMPETITION FOR A CITY HOUSE, THIRD PRIZE.

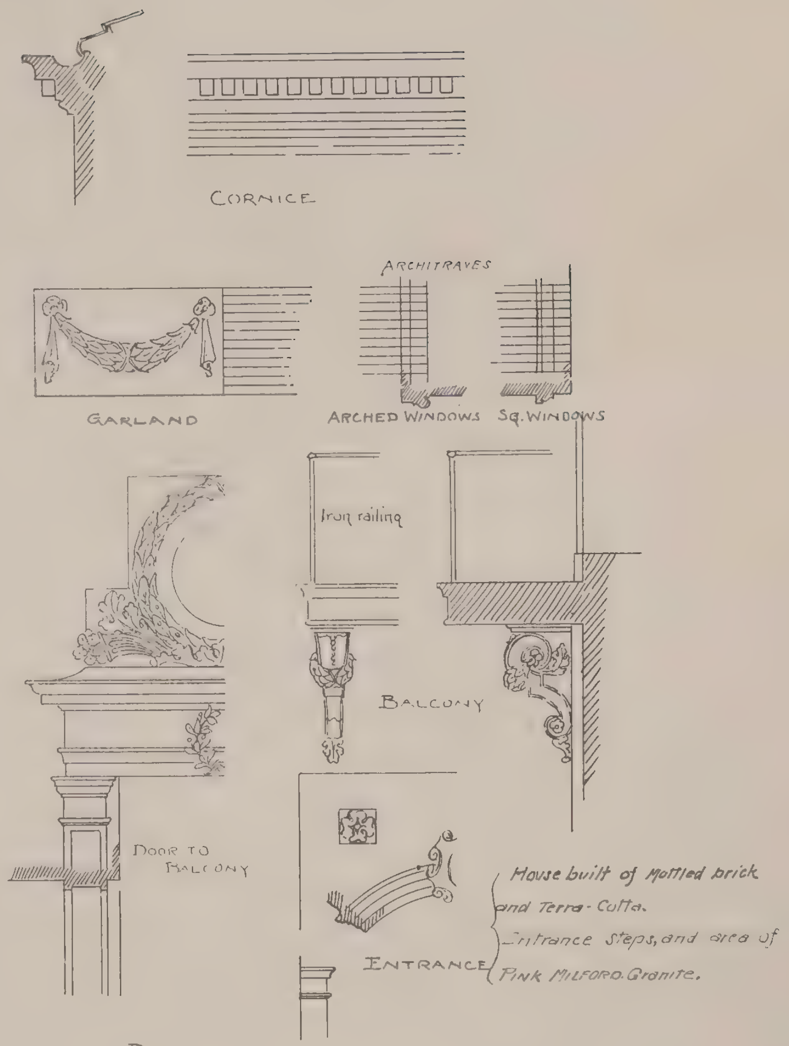
THOMAS WIGHT, NEW YORK, N. Y.



FIRST FLOOR PLAN



SECOND FLOOR PLAN



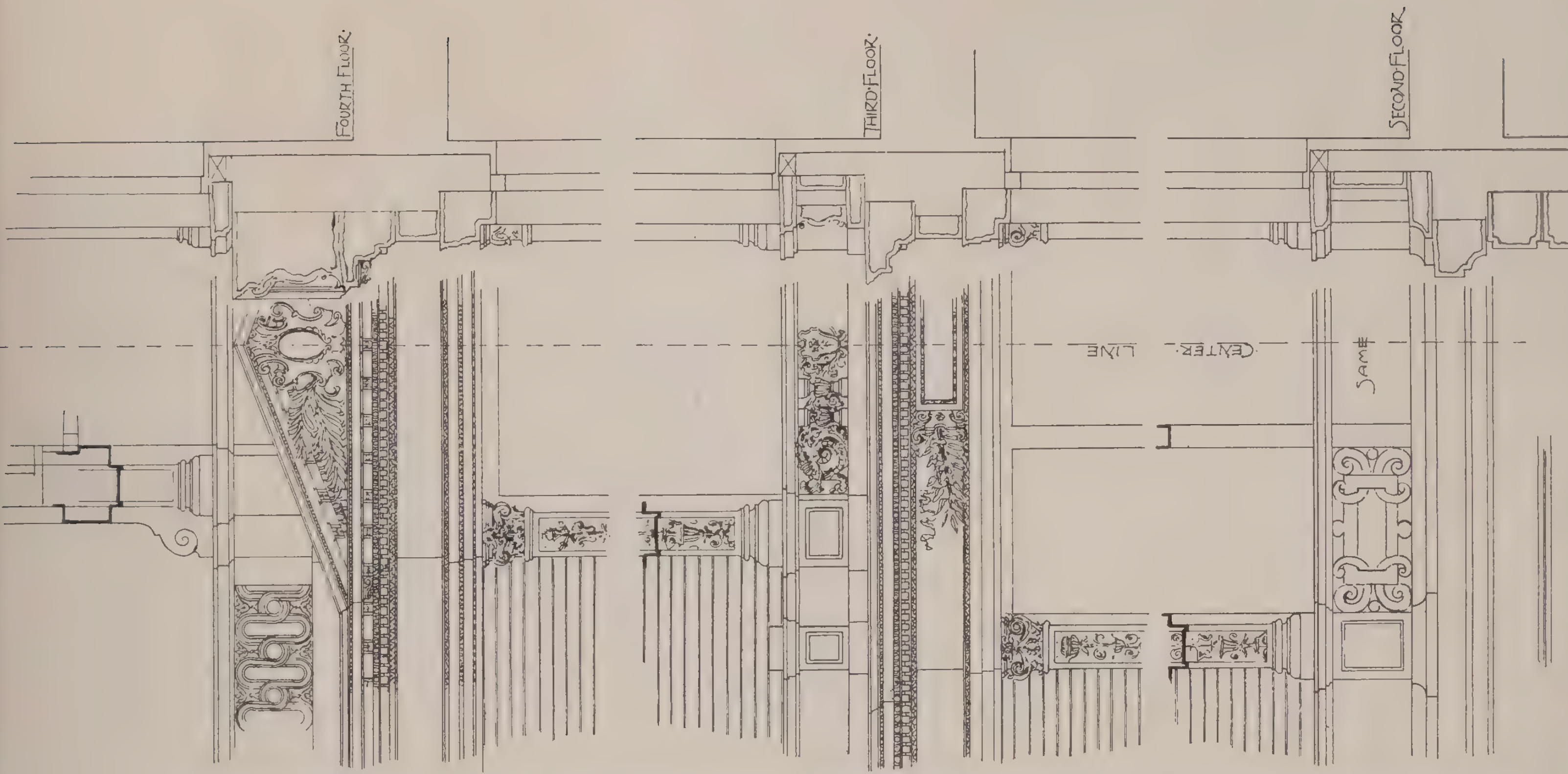
House built of mottled brick and Terra-Cotta.
Entrance steps, and area of Pink Milford Granite.

DETAILS

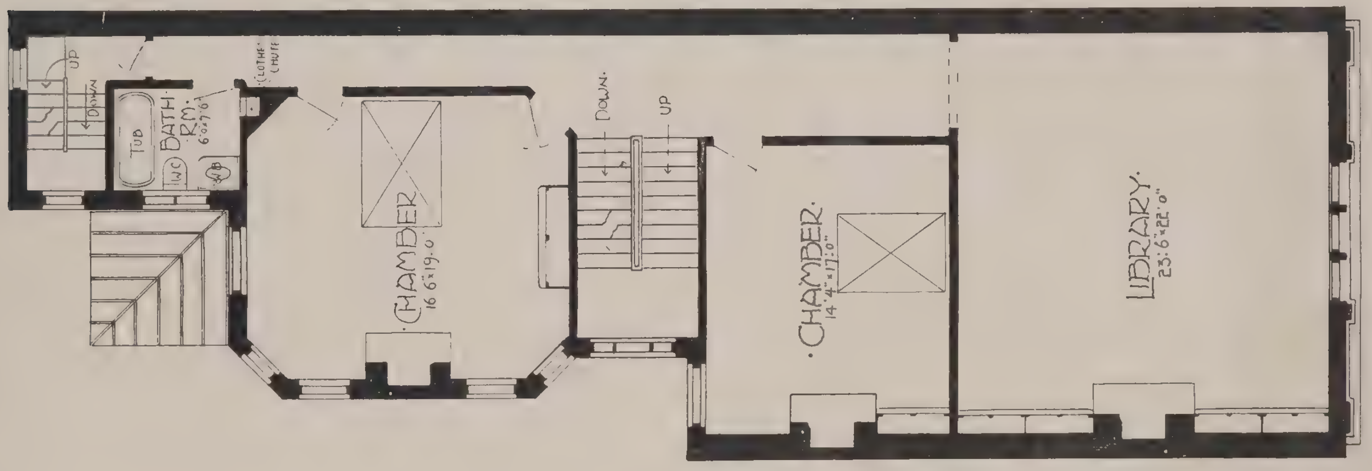
BLVENOSE

THE BRICKBUILDER COMPETITION FOR A CITY HOUSE. THIRD PRIZE.

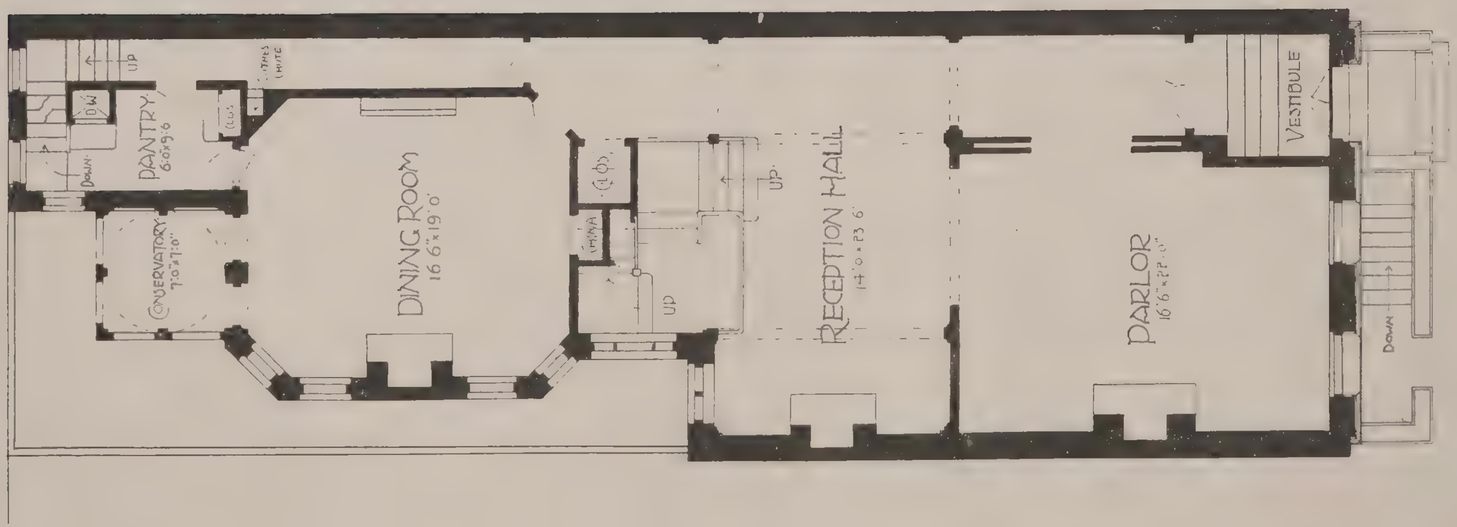
THOMAS WIGHT, NEW YORK, N. Y.



·Details·Section·



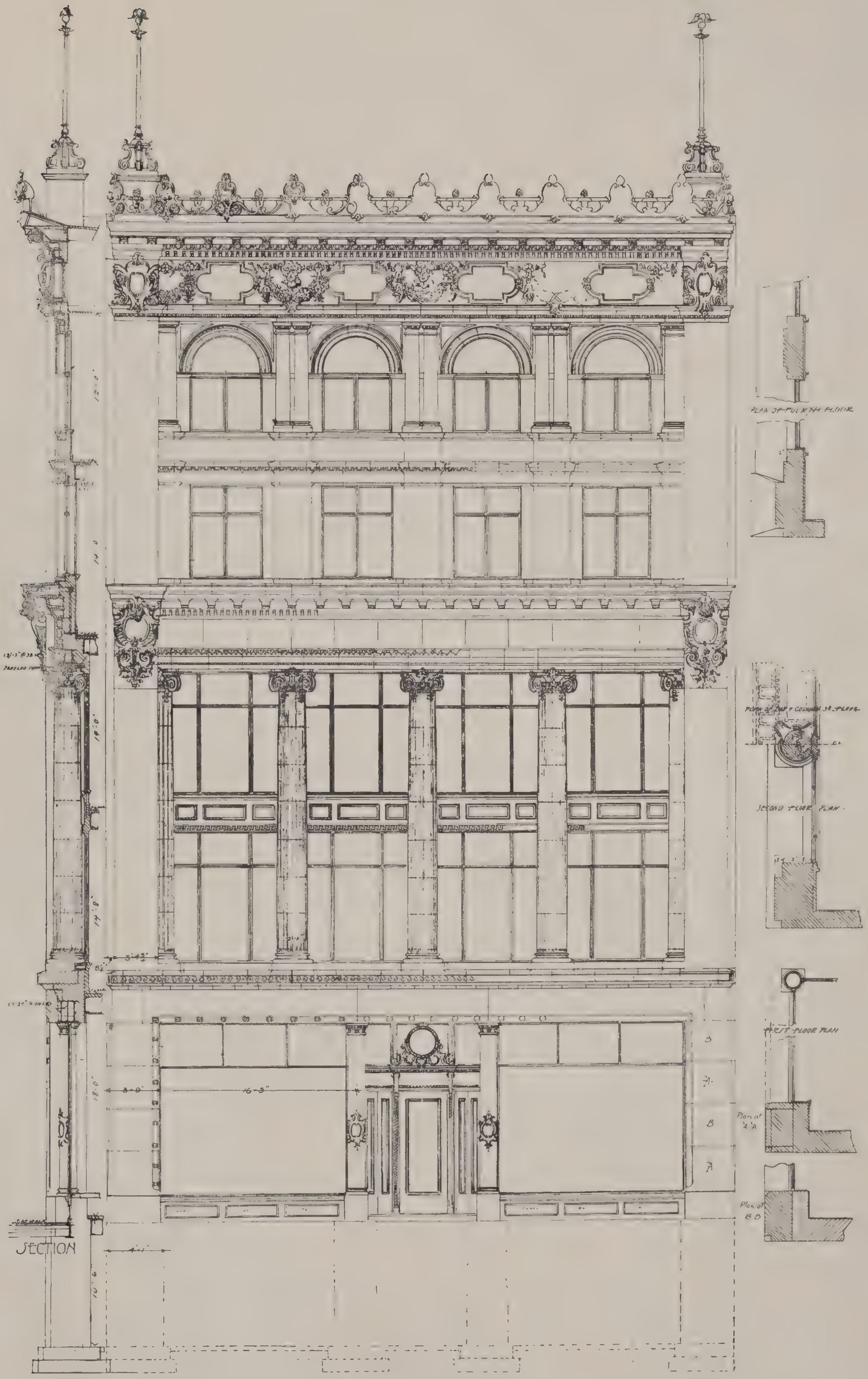
·Second·Floor·Plan·



·First·Floor·Plan·

“Français”

DESIGN SUBMITTED IN THE BRICKBUILDER COMPETITION FOR A CITY HOUSE.



FRONT ELEVATION, CHAPIN BUILDING, BUFFALO, N. Y.

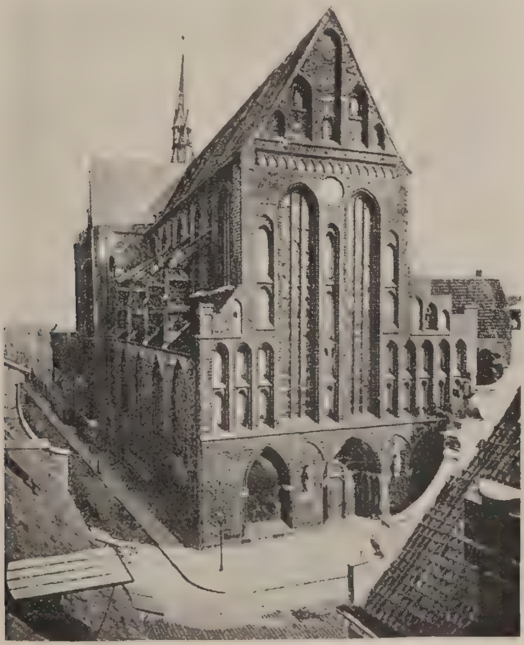
E. A. KENT, Architect.

ARCHITECTURAL TERRA-COTTA.

BY THOMAS CUSACK.

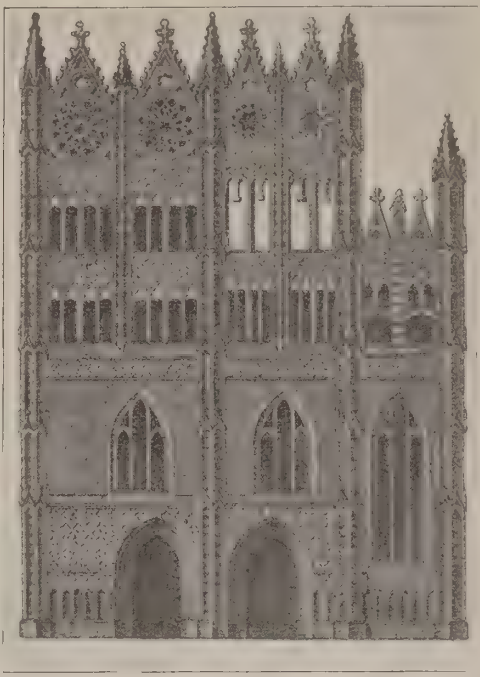
(*Continued.*)

IF the boy is father to the man, so is the ordinary building brick the forerunner of all other shapes and sizes of burned clay that have been used in endless combinations from time immemorial. Taken together, they have a common origin, a natural affinity, inalienable associations, and the same manifest destiny. A word, then, on an important and serviceable class of architecture, in which a brick has been the unit of measurement. For some of the best instances of this, we turn to the Baltic provinces of the German Empire, which are literally studded with brick buildings of very considerable magnitude and high architectural merit. From the Ems to beyond the Vistula the self-reliant old-time architects of Northern Germany studied the physical characteristics of the chief building material within reach, either geographically or financially. The Gothic churches, castles of the territorial rulers, municipal and domestic buildings which they erected all show that their painstaking efforts were not made in vain. To an unmistakably practical knowledge of their materials they added much originality of thought and a fertility of resource that proved equal to every emergency. The harmonious and highly successful combinations which they were able to make of brick and terra-cotta will be found exemplified on every hand in most of the towns of Hanover, Macklinburg, and Pomerania. In the town of Macklinburg there is the church of St. Catherine, which has often been referred to as a conspicuous example of the class of building under consideration, and the church of St. Mary in the same town shows what can be done with a very limited range of materials, when their arrangement is in the hands of a man who has mastered their geometrical and mechanical possibilities. In it the whole thing is executed in black glazed bricks, set in projecting patterns, and in alternating bands on a ground of red brickwork. These and other combinations were made to produce the same general effect as had been obtained elsewhere by the insertion of colored marbles or by an incrustation of costly mosaics. And if the result be at all lacking in refined detail, or if it appears less ornate under minutely critical inspection, it must be remembered that it was obtained at vastly less expense, and that it is free from the elements of sham, which is more than can be said for any form of mere surface decoration. These buildings convey the impression of life and simple vigor, which is not only in keeping with the style, but indicative of the people by whom and the purposes for which they were erected.



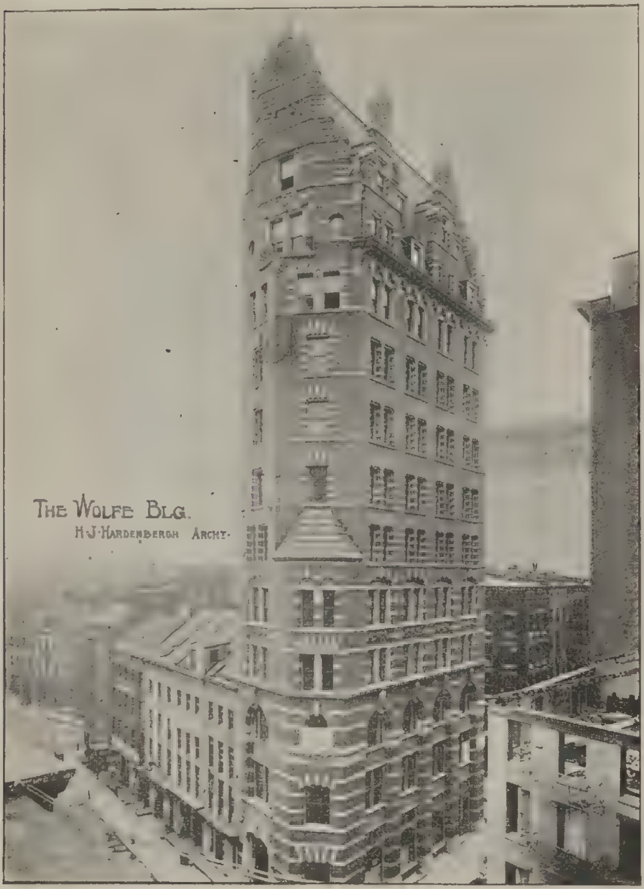
CHURCH OF ST. CATHERINE, LUBECK.

The brick buildings of Spain are numerous, and some of them well known. During the Middle Ages brickwork seems to have been carried out on a very extensive scale, in some districts but little else being used. The towers of Tarazona, Toledo, and Saragossa, whether leaning or vertical, are very striking erections. Many of them have the strength and solidity inspired by Roman traditions, with the rich detail and reticulated ornament easily traceable to the Moors. Brick was also the popular building material in the south of France, more especially in the neighborhood of Toulouse, where some very ancient and excellent examples may be found. The church of the Jacobites may be instanced as a good type of these. It drew from Viollet le Duc the very decided opinion of being "one of the most beautiful brick churches constructed in the Middle Ages," which was praise, indeed. It is now used for military purposes, but is in a good state of preservation, and is worthy of being cared for as a national monument. Its octagonal tower, of bold Gothic outline, bears a strong resemblance to the world-famous belfry of Bruges.



PORTION OF FACADE, CHURCH OF ST. MARY, BRANDENBURG.

Belgium is preeminently a country of brick buildings of early date and much architectural interest. There was a time when Flanders had a foremost rank among the commercial centers of Europe. The money-lenders of Antwerp were not prone to bring down the rate of usury, and when patronized, as they were frequently, by the crowned heads of Germany, France, and England, their ducats brought a return of twelve per cent. Guicciardini asserts that at the beginning of the sixteenth century, at certain seasons, two thousand five hundred ships anchored in her harbor at one time, and that "it was usual for five hundred ships to come and go in one day." The chief cities could therefore well afford to build churches, bourses, city halls, and other public buildings on a scale of corresponding grandeur and magnitude. The town hall of Xpres was commenced in 1230, and its erection covered a period of more than a century. It is 470 ft. long, and its builders were slow; but they never doubted that they were engaged on something that would remain after them, and so they piled brick on top of brick with unwearying patience and deliberate intent. Les Halles, or Cloth Hall, of Bruges, with its renowned belfry, and the older portion of the neighboring church of St. Sauveur are of nearly the same date, and, taken together, these comprise three of as worthy and well-known erections in brick as can be found in any age or country. They have all been the scene of many pilgrimages, and sources of perpetual inspiration alike to artists and architects in search of the picturesque. Xpres, Bruges, Antwerp, Mechlin, etc., are still the Mecca of modern architects, who, uniting business with pleasure, spend their holidays in quest of a style. The wealth and variety of the suggestions to be found there have helped some of them to conjure up new and very successful combinations of form and color, first in England, and now in America. This interchange of ideas and comparing of architectural notes have, in our age of easy travel and free intercourse, become international. We now hear of the Tudor Gothic of Oxford and Cambridge being transplanted in Ostend and elsewhere, though none of our own skyward business blocks have yet been reported from either "the lazy Scheldt or wandering Po."



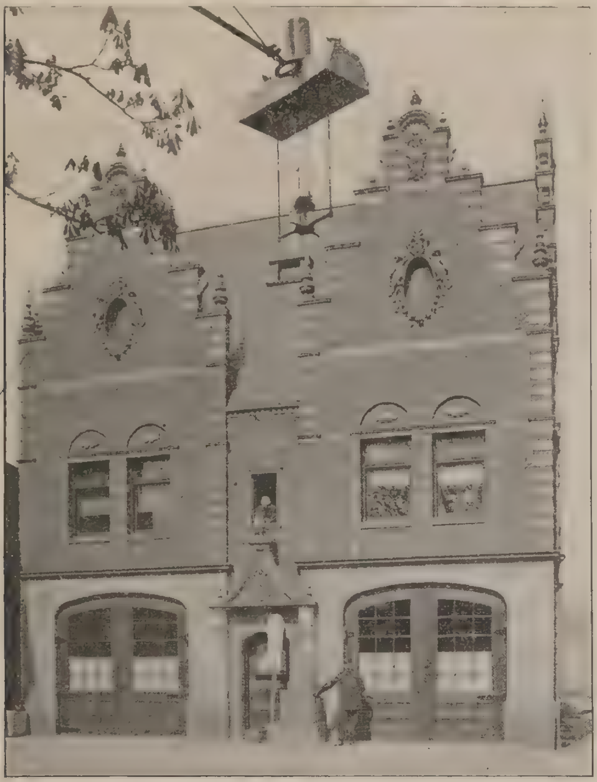
Holland differs but little from its neighbor in matters of style or the kind of materials used, unless it be in the direction of greater modesty. The phlegmatic countrymen of Rembrandt adhered to their own sense of the artistic, until they created for themselves something that is national and indigenous. Their style is vernacular; it makes no pretense of being founded on any classical precedent, but to them it is much better as it is. It is certainly well suited to the needs of domestic architecture and admirably adapted to the nature of the material commonly used in the Netherlands. In its total absence of ostentation it is typical of a proverbially industrious and unpretentious people. To them, in fact, it is like Audrey in the eyes of Touchstone, "a poor thing, but mine own." Holland, no less than Belgium, has been explored of late years, and the architectural tourist has had no reason to come away empty-headed, nor yet empty-handed, in so far as subjects for his sketch-book are concerned. Both countries are rich in dainty architectural conceits and quaint methods of treating the most ordinary features of a brick building that seems to lift it out of the commonplace and invest it with a character and individuality of its own.

Of these we have the gabled façade of crow-stepped or curvilinear outline, sometimes with curved horns projecting at regular intervals; mullioned windows, with elliptical arches, frequently recessed in jambs of molded brick to a height of two or three stories, producing a vertical as distinguished from a horizontal effect; pedimented and many finialed dormer windows, rising so high and reaching so near the verge of stability as to call for wrought-iron supports, affording much scope for ornamental bands and scroll work; overhanging upper stories, corbeled and arched projections, carved and cusped brick panels, with here and there a suggestion of Gothic tracery. Well-designed chimney stacks are made a prominent feature; octagonal belfrys, hexagonal turrets, and eccentric-looking tourelles are to be seen in great variety and profusion. Most of these characteristics are now being reproduced very freely in America, which, truth to tell, is no great misfortune in a land of lingering Knickerbocker traditions, and especially in a city once called New Amsterdam and the domicile of a flourishing "Holland Society." One real misfortune is that our latest importation of style is often too much like a duplicate of the original, and where this is not so there is a tendency to degenerate into what has been facetiously described as Queen Anne in front and Mary Ann towards the rear. Another one, equally real, is that our face-brick are laid in a veneer of all stretchers, instead of the genuine Flemish or English bond, either of which is sound and substantial, and capable of producing a far wider range of pleasing optical effects.

The quaint old Market Hall of Haarlem has, by the way, become a wonderfully prolific prototype of late years. It has already furnished the predominating motif in several interesting combinations of terra-cotta and brick in various parts of this country, which, though not in chronological order, may be referred to here briefly for sake of a continuity of ideas. Chief among these comes the Collegiate Church, on Seventy-Seventh Street and West End Avenue, New York City, by R. W. Gibson. This is not by any means a copy, but a legitimate and frankly avowed adaptation of certain familiar features of that curious old building, modified on the one hand, and expanded on the other, to suit a different site, to harmonize with very different surroundings, and treated so as to come into conformity with wholly different associations. The much discussed and as much admired Wolfe Building, Maiden Lane, William and Liberty Streets, New York, betrays the same source of inspiration in many of its details. Beyond this, the extreme height of the building and the exigencies of the site put an end to further comparison. As has been elsewhere observed, the treatment of the mass is free and well fitted to a most inexorable environment. Having once seen this building, one comes away with the fixed impression that the architect had studied the ancient example in the light of a modern necessity,

RESIDENCES IN INDIANAPOLIS, IND.
Louis H. Gibson, Architect.

until he became master of both. There is an engine house in Rochester, N. Y., by Nolan, Nolan & Stern, a leading firm of architects in that city, who freely admit that the initial suggested for it originated in the land of dykes and windmills. They, too, have taken advantage of the vigor and adaptability of the gable façade, and the result may be counted as one more picturesque and very appropriate municipal building in brick and terra-cotta that reflects credit on the judgment of those engaged in its erection. There is a well-conceived and variously treated group of high-class private dwellings on West End Avenue, New York, taking in the entire block between and extending some distance along Eighty-Fourth and Eighty-Fifth Streets. Of these Frank Miles Day, of Philadelphia, is the architect. A speckled buff Roman brick and cream-white terra-cotta are the materials used above the stoop line, and the effect is harmonious and attractive. The style at first sight might be called Flemish, but on closer inspection it will be seen that the immediate inspiration came from Chelsea Embankment, or Harrington Gardens. In these and many other newly built up districts in the great West End of London, Earnest George & Peto, Norman Shaw, and T. E. Colcutt, etc., have within the past dozen years produced an Anglicized version in which the best features of the originals are deftly blended with others of native growth and with new departures of marked originality. In the work of these architects a consistent modern domestic style has been evolved that is worthy of study, and will be found capable of further adaptation to the varying conditions and requirements of American life. It is essentially an architecture of brick, admirably suited to the employment of clay products such as are now under consideration and within the reach of all classes of the community, from the multi-millionaire to the man of more limited means.



ENGINE HOUSE, ROCHESTER, N. Y.
Nolan, Nolan & Stern, Architects.

(To be continued.)

New York City is putting a great deal of money into important real estate improvements. The value of the new buildings begun in the city during the first six months of the year shows an increase over the same period in 1894 of more than $32,000,000.

BRICKWORK IN NEW YORK CITY.

A STUDY of the constructive and ornamental brickwork existent or at present proceeding in New York City is well worth an examination, as it embraces almost every description of construction and the use of the best and most modern materials, in addition to the high class of workmanship which their excellence warrants. As a resident of the city, I have had plenty of opportunity to examine it, and am pleased to give the result to The Brickbuilder.

In the absence of any skew arches, which, undoubtedly, entail the best bricklaying, I think the series of elliptic arches which span the transverse roads through Central Park, at 66th Street, 86th Street, and 92d Street, are the best specimens of constructive brickwork on a large scale in the city. Fig. 1 will give the reader a clear idea of the construction. As will be seen, they are elliptic arches, having brownstone faces and abutments, the interior soffits and arches being of brick, as seen in the illustration. The bricks are laid in cement to a close joint, and are evidently North Rivers, very hard and selected with a smooth edge. In spite of the fact that these arches have been in position since Wm. M. Tweed's administration, and that a soakage of water from the roadways above is percolating through the soffits, they are still sound, with the exception of an odd brick here and there which has dropped down, either from being small in dimensions or imperfectly bonded. These arches are well worth examining, as elliptic brick arches are not often built now, engineers considering them weak at the haunches; but their beauty of design and graceful outline add to the effectiveness of the landscape.

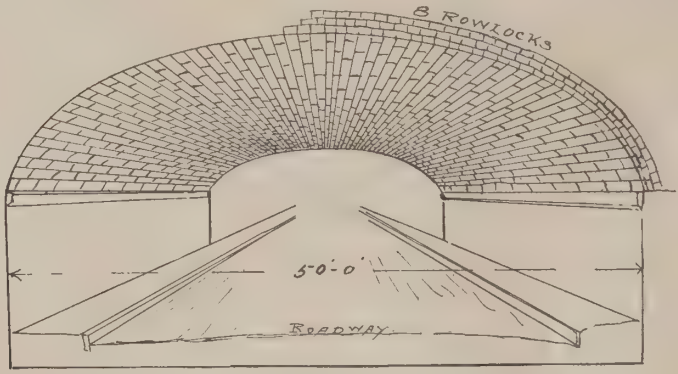


FIG. 1.

Fig. 2 is the scheme of the arches being turned on the new bridges at 90th Street and Cathedral Parkway. It consists of a series of chordal arches turned in between the steel I beams, the skew-back of the bottom ring or rowlock resting on the bottom flange of the beam, as seen in the illustration. Peculiar centers were required for these arches on account of the tie-rods coming through the arch and showing on the soffit. They were so constructed that the lagging of the center stopped at one side of the rod and commenced on the opposite side, thus permitting the center to be lowered

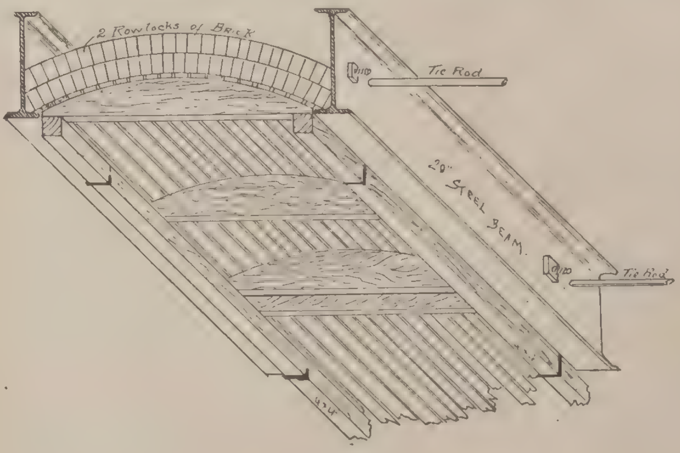


FIG. 2.

down and raised up again after the cement had set. The lagging was laid close and the bricklayers worked directly on it, grouting and pointing the joints as the courses were laid from the skew-back to the key. These arches are 4 ft. 11 ins. wide and 22 ft. long. The centers were hung on hooks for lowering purposes and lowered with ropes.

Fig. 3 will give a clear conception of the manner in which the hooks and clips were made to hang over the I beams, and the nut was used for the purpose of raising or lowering the center to regulate the pitch of the skew-back.

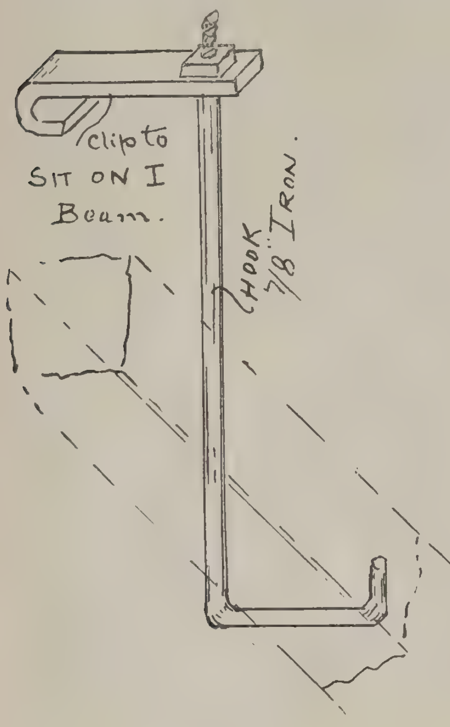


FIG. 3.

I will now draw attention to the circle over circle arch now very generally being introduced on flats and apartment houses. This is caused by architects rounding the corners of their buildings where streets cross. If the elevation of the windows have a circular head, then the brick arch is twisted and oftentimes gives the front bricklayer much trouble in turning his arch, especially where the center is insufficient. A job of this kind is now being erected at the corner of 126th Street and St. Nicholas Avenue, but is not so troublesome, as the brick are easily rubbed or chipped down. In cases where hard mottled brick are used, it is best for the architect to give a diagram of the arch to the brick manufacturer and have the voussoir brick specially made. The work of this kind, however, which has been executed so far is very good, but the corners are of sharp radius and the windows narrow. Flat, circular arches, or "*brick lintels*," as our English cousins term them, are now greatly in vogue, and are simple to turn, the only important matter being the setting and pointing of the joints. Speculative cheap buildings now being erected here have, as a rule, much inferior facework to that put in the building described in the foregoing, which is intended for a hotel, but the general standard of the work as a whole is getting better every year. The improved quality of the brick now on the market warrants this and improves the workmanship. So much is this evident that I can cite several houses which the owners painted over and had brought out to represent mottled brick, claiming that the improved and modern appearance of the property would bring him a better paying and more respectable class of tenants. In a word, appearance in exteriors goes far in this cosmopolitan city towards making renting property profitable, and the brickwork and terra-cotta predominate in designing or attractive building.

I think the best brickwork at present being done in the States is on the new St. Luke's Hospital, on Morningside Heights. The front brick is of a yellowish tint, and each brick comes to the building wrapped in tissue paper. As far as I can learn, they were specially made for this job and are, like the whole construction, excellent. Much credit must be given to Mr. Townsend, the superintendent, for his close watching of every detail.

For the student of architecture and building or for the apprentice bricklayer, I know of no better school than using his eyes in the streets of New York. OWEN B. MAGINNIS.

Fire-proofing Department.

Conducted in the Interest of Building Construction to Prevent Loss by Fire.

FIRE-PROOF FLOOR ARCHES.

(*Continued.*)

BY GEORGE HILL, C. E.

FIRE-PROOF FLOOR FRAMING.

INTIMATELY connected with the subject of fire-proof floor arches, forming, in fact, the other half necessary to make the complete whole of a fire-proof floor, is the subject of the framing which supports the arch. Whether we consider it from the point of view of owner, architect, engineer, or builder, we must keep the two parts in view, and in order to accomplish correct results must give each its due weight in proportion to the work which is to be done between them. Before, however, we can finally determine any of the elements, we must co-ordinate them with the building in which they are to be placed, so as to be assured that for the combination of locality, site, use, and expense we are obtaining a result with the minimum of cost and maximum economy.

In considering the floor framing, it is necessary to take into account not alone the girders and beams, but also the walls or columns which support them. The whole subject is susceptible of being brought within the control of certain general laws which it will be our endeavor to lay down.

We will consider, then, *first*, the question of columns or other points of support. Usually, it will be found that the current work in various localities tends toward putting in as few supports as possible, and an investigation of the way in which this practise developed will usually trace it back to a condition of affairs totally different to those existing at the present time.

Keeping in mind that the work that we propose to do will, if it is well done, be good architecture, we must have our plans symmetrical. The points of support which we determine on should be uniformly placed and occur in natural locations, and by this we mean that if the front of our building is divided into seven bays our points of support should come immediately in line with these bays, and not be so disposed as to have five or six. Then, again, the axes of our buildings should be marked by openings, rather than by piers, and so in a 50 ft. front it would be bad practise if we designed a central row of columns running down to a central pier in the façade. The uses to which the building is to be put, and the peculiarities of the locality, by which we mean North, South, East, or West in the country, will, in a general way, determine the advantageous size of a subdivision in an intended building. This peculiarity is also to be observed in different parts of the same city; thus, in certain parts of New York, a building in which the offices average 10 ft. wide and 15 ft. deep will rent to far greater advantage than an adjoining building in which the offices are 15 ft. wide and 20 ft. deep, while in other localities the smaller office would go begging. Again, in certain locations in Philadelphia, and also in Chicago, offices 18 ft. wide and 20 ft. deep, with an inner office 12 ft. or 15 ft. wide, poorly lit, are in much demand for certain classes of tenants.

The width of the subdivisions makes it desirable that the points of support should be a distance apart equal to some multiple of the subdivision, so that space may not be lost by a column coming in the center of a room, — a peculiarity that will be observed in many published plans, which, however, is not only bad architecture and absolutely inexcusable, but has always been attained by a greater outlay than would have been necessary had the designs been properly made.

In buildings required for mercantile purposes, or, as they are designated in New York, lofts, where there are no subdivisions, the natural tendency is to decrease as much as possible the number of columns which are employed, and here other considerations, which will be subsequently noted, are involved.

Second. — The uses to which the building is to be put, and the commercial limitations upon the depth of the beams which can be rolled, will affect the spacing materially, since, while we must always keep in view the need for stiffness in our floors, and therefore make the depth always at least one twentieth of the span, we must also keep in mind the fact that where manufacturing is going on the tendency to vibration is very great; and wherever there is vibration, the tendency to synchronism in the vibration is always great, and, in consequence, the stiffness of the floor should be materially increased to guard against it.

Third. — The exposure of the building to the light, and the effect which projecting girders have upon the travel of light along the ceiling, is very noticeable. A room which has an absolutely flat, smooth ceiling will be better lit than the same room with projections below the line of the ceiling in direct proportion to the number of projections, and the projections themselves will have more effect on cutting off the light if they run in a northerly and southerly direction than if they run in an easterly and westerly direction.

Fourth. — The closer the columns are spaced together, the less weight of metal will be required both in the floor and in the supports, and the less expensive will the floor blocks be, taking as a minimum a spacing of 10 ft. by 11 ft. 3 ins. The only limitations or exceptions to this rule are those imposed by expensive erection and excessive thickness of metal in the columns due to the practical requirement that cast iron should be not less than ¾ in. in thickness and rolled iron or steel not less than $\frac{5}{16}$ in.

In the *American Architect* for March 17, 1894, the writer published two tables giving in detail data referring to fire-proof floor frames and weights of columns, and the interested reader is referred to these tables as a means of intelligently studying the problem of construction which he may have. They may, however, be briefly summarized, as has been done below, and the framing actually designed, keeping in view the principles above noted. These tables were calculated on a basis for the beams of taking the maximum and minimum weights of each size of beams rolled from 6 ins. up to 15 ins.; determining the maximum span on which it was safe to use these beams for office building floors, and then finding the maximum spacing for a fiber strain of 12,000 lbs. per square inch, and ascertaining the most economical girder to be used, the length of the girder being three, four, or five times the beam spacing. As a consequence, the number of square feet of floor supported ranged from a minimum of 112.5 sq. ft. to a maximum of 666.67 sq. ft. The weights of framing for both beams and girders for these various spacings per square foot of floor supported are also given. There were also given memoranda concerning the sizes of floor arch blocks which can be safely used in connection with the above, indicating which is the more economical to use. In another table is given the weight of column required to support 100, 200, or more square feet, and from one to twenty stories in height; the column weight running from about 500 up to 53,000 lbs.

TABLE I.

WEIGHTS OF FRAMING.

Beam lengths are given first; then lengths of girder, and then weights per square foot of floor supported.

10′ 0″ by 10′ 3″ — 5.6	10′ 0″ by 15′ 0″ — 6.7	10′ 0″ by 18′ 9″ — 7.6
10′ 0″ by 12′ 0″ — 6.55	10′ 0″ by 16′ 0″ — 8.1	10′ 0″ by 20′ 0″ — 8.8
11′ 8″ by 11′ 6″ — 6.18	11′ 8″ by 15′ 4″ — 7.42	11′ 8″ by 19′ 2″ — 8.2
11′ 8″ by 13′ 6″ — 7.16	11′ 8″ by 18′ 0″ — 8.44	11′ 8″ by 22′ 6″ — 10.5
13′ 0″ by 12′ 0″ — 6.65	13′ 0″ by 16′ 0″ — 7.66	18′ 0″ by 20′ 0″ — 9.12
13′ 0″ by 15′ 0″ — 7.17	13′ 0″ by 20′ 0″ — 9.02	13′ 0″ by 25′ 0″ — 11.4
15′ 0″ by 11′ 9″ — 7.36	15′ 0″ by 15′ 8″ — 8.11	15′ 0″ by 19′ 7″ — 10.63
15′ 0″ by 15′ 9″ — 7.94	15′ 0″ by 21′ 0″ — 10.67	15′ 0″ by 26′ 3″ — 13.2
16′ 8″ by 12′ 9″ — 7.98	16′ 8″ by 17′ 0″ — 9.30	16′ 8″ by 21′ 3″ — 11.47
16′ 8″ by 16′ 6″ — 8.88	16′ 8″ by 22′ 0″ — 11.77	16′ 8″ by 27′ 6″ — 13.68
20′ 0″ by 13′ 3″ — 9.24	20′ 0″ by 17′ 8″ — 11.77	20′ 0″ by 22′ 1″ — 12.70
20′ 0″ by 16′ 9″ — 10.1	20′ 0″ by 22′ 4″ — 13.1	20′ 0″ by 27′ 11″ — 14.08
25′ 0″ by 13′ 0″ — 12.36	25′ 0″ by 17′ 4″ — 14.25	25′ 0″ by 21′ 8″ — 16 2
25′ 0″ by 16′ 0″ — 13.31	25′ 0″ by 21′ 4″ — 16.3	25′ 0″ by 26′ 8″ — 17.1

TABLE II.

Table of column weights; read from small plot, and therefore not absolutely correct. Calculated for office buildings and for a decrease in the live load as the number of stories increases.

No. of Stories.	Area Supported.				
	100	200	300	400	500
1	550	550	550	550	550
2	800	900	950	1,000	1,000
3	1,200	1,400	1,400	1,800	2,000
4	1,600	1,800	2,000	2,800	3,200
5	2,000	2,400	2,950	3,900	5,800
6	2,450	3,000	3,900	5,100	6,500
7	2,800	3,800	5,100	6,900	8,600
8	3,300	4,600	6,500	8,800	10,600
9	3,700	5,600	8,000	10,500	13,000
10	4,200	6,600	9,500	12,500	15,800
11	4,800	7,800	11,200	15,000	18,700
12	5,400	9,000	13,000	17,200	21,700
13	6,000	10,300	15,100	20,100	25,000
14	6,700	11,800	17,000	23,000	28,500
15	7,400	13,100	19,100	25,600	31,900
16	8,100	14,700	21,600	28,900	35,800
17	9,000	16,300	24,000	32,000	39,900
18	9,900	18,000	26,800	35,500	44,000
19	10,800	19,800	29,300	39,000	48,500
20	11,600	21,500	31,800	42,400	53,000

The proper procedure, then, in the laying out of the floor framing is to have the columns disposed in symmetrical and natural lines where they will fall on natural division points in the completed building, running through continuously from foundation to roof, unless there is some special reason in the upper stories for the omission of certain of them. Under no circumstances is it either good architecture or good engineering to do stunts in the way of supporting columns over big rooms by heavy trusses, building trusses in partitions, and other similar matters, and such a condition of affairs, therefore, should be avoided. The most effective disposition of the columns and girders can be determined by trying various spacings which come within the divisions of the building and ascertaining the weight per square foot of floor corresponding thereto from Table I., and multiplying it by the number of stories and adding thereto the weight of column from Table II., determining the weight by interpolation from the even areas given, and selecting that disposition of the columns which gives the lowest result. The cost of erecting columns is generally figured as an increase on the base charge per pound, and not by the number of columns, so that, unless there is a marked difference in the number of columns, that result will be the most economical which has the least weight per square foot of floor supported, taking into account both floor framing and column weight.

In all of the above but little has been said concerning the limitation of depth of floor arch block on beam framing, for the simple reason that the 12 in. block, which is the largest size manufactured, is amply strong for the greatest spacing of beams which we have considered. Buildings require flat ceilings, and so segmental arches are debarred, and they also require to be made as rigid as possible in a horizontal plane, and so any thin, flimsy floor construction which might bear the vertical loads sufficiently, but no other, is debarred.

The question of the proper depth of block to use for filling to meet particular cases within the limiting spans required by Table I. will be considered at the end of the articles on Fire-proof Floor Arches.

A fire recently occurred in the basement of the new Carter Building, Boston, which is used as a restaurant, that, undoubtedly, would have developed into a serious conflagration had it not been that the piers of the building were protected by fire-proofing, the whole building, in fact, being fire-proof construction.

The fire, which started in the early hours of the morning, probably as a result of defective electric wiring, destroyed a lunch counter which was built between two piers and a large closet containing the table linen, but had nearly burned itself out before the arrival of the firemen. A new lunch counter and linen closet, the plastering patched, a coat of paint, and all was as good as new.

Mortars and Concrete Department.

Devoted to Advanced Methods of using Cements and Limes in Building Construction.

STANDARD SPECIFICATION FOR CEMENT.

REPORT OF THE COMMITTEE ON "ARCHITECTS' PLANS AND CONTRACTS" OF THE MASTER BUILDERS' EXCHANGE, PHILADELPHIA.

AT a quarterly meeting of the Master Builders' Exchange of Philadelphia, held September 24, the question of standard cement specifications was brought up for final action by the Committee on Architects' Plans and Contracts, submitting their report as to what a standard specification of cement should be. After some discussion the report was unanimously adopted, and the secretary of the exchange ordered to have sufficient copies printed for distribution.

There was some question as to whether the required strength for Portland cement should not be higher. Mr. Jos. E. Balliet, president of the "Saylors Portland Cement Works," being present, was asked by Mr. Gillingham, president of the Master Builders' Exchange, as to his opinion of the matter, and in response said that, although the cement manufactured by his company stood higher tests than those mentioned, when properly tested, he thought these tests were high enough to prevent a faulty cement from being used, and also would not confine the bidding to only a few brands.

Mr. Robert W. Leslie and Mr. Ralph Peverley followed, stating that the strength required by these specifications would prevent the use of inferior cements. There was considerable question in the minds of many of the members present as to the advisability of having two classes of tests. Mr. Francis G. Schumann, chairman of the committee which submitted the report, upon being questioned about the idea, said he thought these specifications were the first to make a distinction between the tests made under proper methods and those made on work by inexperienced people. From investigations carried on by the Engineer Commission at Washington, D. C., and by the Department of Public Works, Philadelphia, it was found that the difference between tests carried on under the two different methods was 25 to 40 per cent.

Whether or not it was advisable to have two forms of specifications was seriously questioned by Mr. Franklin M. Harris, Sr., Wm. B. Irvine, and Wm. G. Hartranft. It really is a serious question whether cement manufacturers should have to submit a cement to pass certain requirements where tests are to be carried on by acknowledged inexperienced people, and we think all our readers will agree that the test which is to be carried on under defined and accurate methods is the most commendable.

THE REPORT.

To the Directors of the Master Builders' Exchange of Philadelphia, Pa.

GENTLEMEN:—Your committee, to whom was referred the matter of standard specifications for cements, beg to submit the following report:—

The desirability, in fact, necessity, of standard specifications for materials used in building construction, has been expressed by the continued agitation of the subject through the various associations affected thereby, such as the civil engineers, architects, and master builders.

While steel and iron are now practically subject to standard requirements, cement, an article fully as definite in its nature and required physical results, is still described in specifications in most vague and varying language, and a diversity of required properties that cannot but create confusion and tend to disputes and litigation.

In the past, when the consumption of cement was but limited and the manufacturers were few, and those confined, practically, to one country, England, it was sufficient to specify the name of the maker or his brand, and because of the integrity of the maker, satisfactory results could be expected.

As the demand increased, its manufacture spread rapidly, extending to all countries. The increased production caused close competition, and, as a natural result, the gradual introduction of inferior cements followed, the making of which was not confined to any one particular maker or country.

As a consequence, old, reputable brands, the quality of which had been maintained by their makers, were generally adopted for the better class of work, to the exclusion of those brands by makers but recently established, yet producing an article equal, if not superior, to that of their older competitors.

Thus, by reason of a lack of a proper standard, purchasers limited their specification to the mention of a brand, excluding the product of manufacturers who were aiming to make the best and compelling them to compete in price with an inferior product.

To foster progress is one of the precepts of this association, and no better opportunity can offer to prove our sincerity than active agitation towards the establishment of a uniform standard specification for cement.

Your committee deemed it wise to precede the specification with certain brief explanatory remarks as an introduction:—

The cements now used in building operations are practically confined to two classes, "Natural" and "Artificial" or "Portland Cement."

A Mr. Parker is supposed to have been the inventor of the natural cement of modern times. A person of that name took out patents in England about the beginning of this century for what he called "Roman Cement."

NATURAL CEMENT, as now made, is from stone in which the lime, silicates, and aluminates are in such ratios that when the carbonic acid is expelled the lime is in such proportions as to make a hard compound with the silica and alumina. These stones are usually found in strata amongst those of hydraulic limestone. After burning they are ground to a powder, which must be kept dry until used. This powder consists of a mixture of lime with silicate of alumina. When made into a paste with water, chemical action takes place, and a double silicate of alumina and lime is formed, which tends to form a compact artificial stone.

Its great utility and difficulties in obtaining the proper stone impelled makers to experiment in producing the article by artificial means having the same characteristics. The continued attempts by different parties in the first quarter of this century finally resulted in the article now known as "Portland Cement," so called from its resemblance, when dry, to the Portland stone in color; a stone found on the islands off the coast of Dorsetshire, England, and of which many of the larger buildings in London are built.

PORTLAND CEMENT, according to the best authorities, is defined to be an artificial cement. It is made by an artificial admixture of limestones and argillaceous rocks, marls, chalks, clays, or other similar materials in the required proportions, mixed thoroughly into a paste with water in a pug mill, making the paste into balls or cakes, drying and calcining them to incipient vitrifaction, and finally grinding them to a powder, ready for shipment in bags or barrels. Portland cement not only possesses the property of setting more quickly and has greater power of cohesion than natural cement, but it may be used with a superabundance of water, which they cannot. It resists the action of the sea water better than all other cements, and is proof against water when used as a mortar and in the composition of concrete for foundations, lining of cisterns, or surfaces of pavements or roads. The ingredients necessary for making this article are found in all parts of the world.

In addition to the two classes of cement above mentioned, there is made in Belgium and in certain parts of Europe a natural cement resembling Portland cement in color, which is made by calcining to a clinker natural cement rocks and grinding the same to powder.

There is also made in America an "Improved" cement, which is made by grinding together natural cement-making material in a calcined condition and Portland cement clinker, and which is sold as an improved natural cement.

It is not the purpose of your committee to originate any items of requirements, but to submit a specification which is in so far a standard, in that it unites and expresses the intents of the specifications emanating from the greater portion of the architects and engineers in this country, which, taken separately, contain sufficient variableness, although having like aims, to cause confusion and doubt in the minds of cement makers as to what is really demanded in an ideal or standard cement.

In conclusion we would remark that the essential of the standard specifications recommended by the Society of Civil Engineers have been incorporated. (See Trans. Am. Soc. of C. E., Vol. XIV., page 475, November, 1885.)

MASTER BUILDERS' EXCHANGE.

Standard Specification for Cement.

REQUIRED TESTS

Shall be for —

- Specific gravity,
- Fineness,
- Checking or cracking,
- Time of setting,
- Excess of magnesia and sulphate of lime in Portland cement,
- Tensile strength.

CLASSIFICATION OF MANNER OF TESTING.

Two classes of tests shall be optional: —

Class I. contemplates the conduct of the tests in a laboratory, designated by the purchaser, having all the necessary facilities and appliances for insuring accuracy and refinement of tests.

Class II. shall be tests made with more crude facilities and appliances, such as can be readily obtained at or near the site of the work, and where the specified conditions as to temperature, moisture, and mode of preparing test specimens cannot be fully met.

PACKING.

No cement shall be received at the works unless securely packed in good tight bags or barrels, properly marked and branded.

INSPECTION.

All cement shall be subject to inspection, and those rejected shall be immediately removed from the work by the seller of such cement.

The purchaser reserves the right to take samples from each lot or each barrel or bag of cement delivered, and subject them to tests either under Class I. or II., and to accept or reject the cement in accordance with the results of the tests.

STORAGE.

The purchaser of the cement is to provide suitable storage facilities for the cement, well protected against the elements. Sufficient cement shall be stored in advance to permit a seven or twenty-eight day test, as may be determined by the purchaser, so as not to delay the progress of the work.

COST OF TESTING.

The cost of the specified tests shall be borne by the seller.

SPECIFIC GRAVITY.

The specific gravity shall not be less than —

2.5 for natural cement,
3.0 ,, Portland ,,

FINENESS.

The tests for fineness shall be with two sizes of sieves: —

No. 50 made of No. 35 wire (Stubbs' gage), 2,500 meshes per square inch.

No. 100 made of No. 40 wire (Stubbs' gage), 10,000 meshes per square inch.

There shall pass, by weight, not less than —

UNDER CLASS I. TEST.

96 per cent. through the No. 50 sieve natural cement.
80 ,, ,, ,, 100 ,, ,, ,,
99 ,, ,, ,, 50 ,, Portland ,,
85 ,, ,, ,, 100 ,, ,, ,,

UNDER CLASS II. TEST.

93 per cent. through the No. 50 sieve natural cement.
75 ,, ,, ,, 100 ,, ,, ,,
95 ,, ,, ,, 50 ,, Portland ,,
80 ,, ,, ,, 100 ,, ,, ,,

CHECKING OR CRACKING.

Cakes or pats of neat cement are to be made 2 to 3 ins. in diameter and about one half an inch thick, drawn to thin edges at the circumference. They must show no indication of checking, cracking, or warping when exposed in the air or water at normal temperatures.

TIME OF SETTING.

The tests for time of setting shall be for "initial" and "hard" set, and shall be determined with pats of neat cement one half inch thick at a temperature of between 60 and 70 degs. Fahrenheit. In making the pats just sufficient water should be used to result in a stiff plastic paste.

In the "initial" set the surface of the pat shall not suffer any impression from the square end of a short round wire one twelfth inch in diameter loaded with one quarter pound weight, while in the "hard" set a one twenty-fourth inch diameter wire loaded with one pound weight shall not cause any impression. "Initial" set shall not develop in less than ten minutes and "hard" set in less than thirty minutes in natural cement, while in Portland the "initial" set shall not develop in less than thirty minutes in "slow setting" Portland cement, and in ten minutes in "quick setting" Portland cement.

SULPHATE OF LIME.

The maximum of sulphate of lime in the form of gypsum or calcined plaster shall not exceed —

2 per cent. in Portland cement.

MAGNESIA

Shall not exceed —

3 per cent. in Portland cement.

TENSILE STRENGTH.

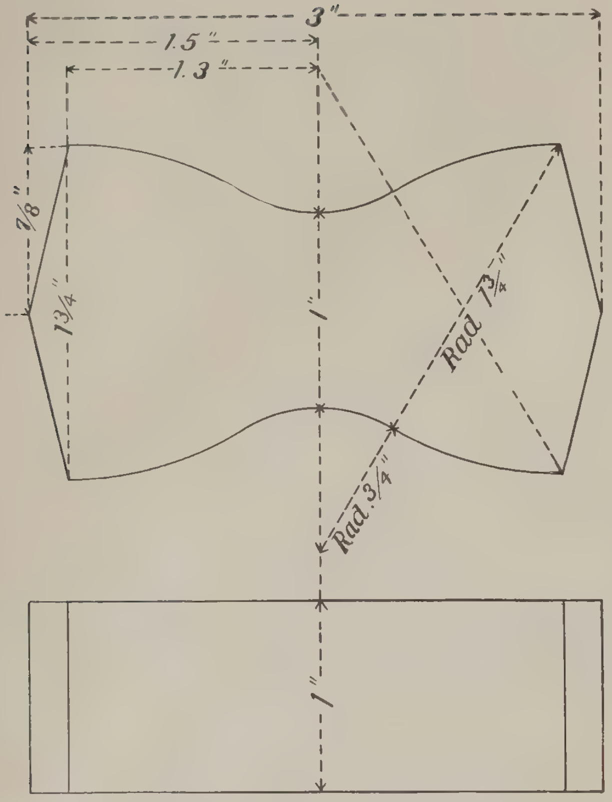
Tests shall be made with specimen pieces in the form of briquettes, as per sketch herewith, made in iron or brass molds.

Two sets of briquettes, of 5 each, shall be prepared, 1 set of neat cement, the other of cement and sand, all carefully proportioned by weight, as follows: —

Natural cement 1 part cement to 2 of sand,
Portland ,, 1 ,, ,, ,, 3 ,, ,,

METHOD OF MAKING BRIQUETTES.

Sand. — The sand must be of crushed quartz, such as is used in the manufacture of sandpaper, perfectly clean and dry, and of such fineness as to pass through a No. 20 sieve (400 meshes to the square inch) made of No. 28 wire, Stubbs' gage, and to be caught in a No. 30 sieve (900 meshes to the square inch), wire to be No. 31, Stubbs' wire gage.



FORM·OF BRIQUETTE. FULL SIZE.

WATER.

Ordinary fresh clean water, having a temperature of between 60 and 70 degs. Fahrenheit, shall be used for the mixture and immersion of the specimens. The proportion of water used in making the briquettes will be about

One fourth the weight of neat cement,
One sixth the weight cement and sand (1 cement, 2 sand),
One eighth the weight cement and sand (1 cement, 3 sand).

MIXING.

The cement and sand of the required proportion shall be mixed dry and all the water mentioned added by degrees, the mixing to be as rapid as possible to secure a thorough mixture of the materials.

MOLDING.

The mixture when stiff and plastic to be firmly pressed into the molds, without ramming, and struck off flush. The molds to rest directly on glass, slate, or other non-absorbent material. When sufficiently hard the briquettes, which are to be made one at a time, are to be taken from the mold and kept covered with a damp cloth until immersed. In the one-day test briquettes shall remain on the slab for one hour after hard set, and balance of time in water. In one-week or longer tests, they shall remain in air one day after being taken from molds, the remaining time in water.

After being taken from the water the briquettes are to be immediately put into the testing machine and the stress applied at a uniform rate of 400 lbs. per minute, starting at zero.

The temperature of the testing-room is not to be below 45 degs. Fahrenheit.

The average *tensile strength* in pounds per square inch of section of each set of five specimens, one hour in air and the remainder in water, shall not be less than

	Class I. Test.			Class II. Test.		
Natural Cement.	1 day.	7 days.	28 days.	1 day.	7 days.	28 days.
Neat	75	150	225	50	125	200
1 cement, 2 sand		80	140		50	100
Portland Cement.						
Neat	125	400	500	100	300	400
1 cement, 3 sand		125	200		90	150

SOME EXPERIMENTS WITH MORTARS.

WE do not often write about mortars, although bricks and mortar invariably go together, but, in the face of the attention which has during the past few months been given to the subject by our foreign contemporaries, we must needs step aside to consider some rather illuminating experiments which have just been made.

Builders are a class of people whom we naturally have to conciliate. They are usually most worthy men, but possessed with various prejudices, whilst their commercialism is admirable, however inconvenient we may sometimes find it. Now, it is a common belief amongst builders, especially amongst bricklayers and foremen, that it is much more advantageous to mix lime-mortar some days before it is wanted, rather than to mix it immediately before the bricks have to be laid.

To test this popular superstition — if we may be forgiven the expression — samples of mortar have recently been taken on successive days from two separate heaps of larger size. Small cubes of bricks were molded from these samples, and set aside for a definite period of weeks, and then broken, in order to estimate their tensile strength.

The following were the results: —

Sample.	Days in heap after mixing.	Days exposed to air as a small brick.	Average breaking stress in lbs. per sq. in.
Mortar No. 1 . . .	3	50	34.6
" " . . .	4	49	38.6
" " . . .	6	48	38.1
" " . . .	7	46	39.3
Mortar No. 2 . . .	4	48	36.0
" " . . .	5	47	38.0
" " . . .	6	46	41.2
" " . . .	7	45	41.5

The amount of calcium silicate formed was found to be exceedingly small, even after very long intervals of time.

Another notion that is very common amongst those who have to deal with the building of bricks into brickwork is that sugar and blood are very good things to mix with the mortars, especially with hydraulic mortars. Consequently, experiments were undertaken to test these views.

Hydraulic mortar tempered with sugar and water, at the rate of half a pound of sugar to the gallon, was found to be considerably stronger than the same mortar tempered with water alone. This was found to be true only if the mortar were allowed to harden exposed freely to the atmosphere. If the mortar were used for subsquares brickwork, no advantage was found to follow upon making the extra expenditure and taking the extra trouble with sugar.

The same mortar was also tempered with bullock's blood, diluted with one third of its volume of water. The mortar was then molded in a brick mold, and was found to set somewhat more quickly. It also showed a considerable increase in strength, both when exposed to the air as well as when laid under water.

Here are some experimental data: —

		lbs. per sq. in.
1.	Tempered with water alone	63.00
2.	" " sugar solution, and exposed to water during 38 days	62.75
3.	" " sugar solution, and exposed to air during 38 days	65.4
4.	" " diluted blood, and exposed to water during 37 days	68.3
5.	" " diluted blood, and exposed to air during 37 days	69.8

So it seems that there is some truth in these old notions; and those who hold them will now be able to give scientific reasons for their faith. — *British Clay Worker.*

The Masons' Department.

Conducted in the Interests of the Builder and the Contractor for Brickwork.

WITH the current number, THE BRICKBUILDER enters upon a new phase of its development, which, we believe, gives promise of usefulness, and it becomes the pioneer, to a certain degree, in a heretofore untrodden field.

The management of the paper has seen fit to change the name of this department, and consequently enlarge its scope so that it shall hereafter not only represent the builder and contractor for brickwork, but it will also seek to reach the firesides of the thousands of industrious craftsmen in this country who labor with the hammer and the trowel, and who by their skill and cunning have been so potent a factor in the production of American architecture. It will be the aim and object of this department: —

First. — To be in the future, as in the past, a medium of assistance and practical knowledge to the mason contractor and keep him constantly posted on all the advanced ideas and improved appliances essential to his welfare.

Second. — To be the firm and steadfast champion of the craftsman in the building trades as long as it is consistent with the well-known principles of this journal. We recognize in him the means upon which the architect and builder depend to gain their ends in the faithful and skilful execution of their plans.

The department will contain articles written by a corps of experienced writers, especially in the interests of the artisan in the several branches of his trade. It will be our constant endeavor to raise the craftsman to a higher standard of efficiency, to bring the product of his labor to the highest degree of excellence, and to place the hand that executes in a closer relation with the brain that conceives.

Third. — To encourage the regulation of our apprenticeship system, to the end that an apprentice must, after serving his time, pass a prescribed examination before being qualified to work at his trade, and having passed a satisfactory examination he shall be given a trade certificate.

Once in operation, builders and architects would require these certificates of workmanship, and the result of this system, we believe, would tend to give the general run of craftsmen a better reputation for good workmanship than they now enjoy, and would attract the most intelligent and desirable boys in the land to take up the mason's trade.

Fourth. — To break down the barriers, real or imaginary, which may now exist between the artisan and architect.

The architect, in the minds of many workmen, is regarded, too often a rather pompous sort of an individual, who can draw a pretty picture of a house, has a good flow of language, and puts on lots of style, although in practice he does not know a cold chisel from a brickset, while on the other hand, many architects consider the journeyman mason, if they think of him at all, as a roving, illiterate and incompetent man, unfit for their confidence or association, and far below them in mental, moral, and social standing. These opinions, on both sides, are generally unjust and untrue.

Schools for the manual training of young men for the various building trades are in successful operation in many of our large cities; schools for the education of young men as architects may also be found throughout the country; both are engaged in a glorious and noble work, but a true philosopher will question whether they are following out their highest ideal or grasping their grandest opportunities, until they shall have united in a common cause and work hand in hand, step by step, until these conditions shall have been ameliorated, which now prevent our craftsmen from rivaling those of Greece or of the Middle Ages. Michael Angelo and Wrenn were the outgrowth of times in which can be seen the beginnings of present conditions. To bring these ideas to a successful realization THE BRICKBUILDER asks for and expects the hearty cooperation of every architect, builder, and workman in the country, who has the best interests of his business at heart, and who would better the condition not only of himself but of his fellow-men.

> The builder's trowel and the settler's ax
> Are seldom wielded by the selfsame hand,
> Ours is the harder task; yet not the less
> Shall we receive the blessing for our toil
> From the choice spirits of the after-time.— *Lowell.*

BOILER SETTING.

SOMETIME in his varied career a mason is sure to be called upon to set a boiler, and the few practical ideas given here may not come amiss.

The foundation of all boilers should be of the firmest character, either of stone or brick, and the best material used throughout.

Less than a 12 in. wall should not be allowed, even in the smallest size of horizontal boilers. Large boilers have 12 ins., 20 ins., and 24 ins. additional to the fire-brick lining of furnace. In setting a boiler, arrangement should be made to carry on combustion with the greatest possible heat. This requires good non-conductors of heat, such as fire-brick, to line the furnace box, and continued over the roof of the boiler. The top of the bridge wall should be of fire-brick and laid as an inverted arch for stability.

The arch over the back connection of boiler should not be turned against the boiler, but should be sprung from the side walls and free one half inch from the boiler. The lugs of a boiler should rest on iron plates, build the wall for the lugs to *give and take* on the rollers; otherwise the expansion of the boiler will crack the wall.

The arch over a boiler should spring from the side walls and be self-supporting, and not turned on the boiler, which should be 1 or 2 ins. from the fire-brick.

Lay strips of wood lengthwise on the boiler and turn the arch on them; when the arch is keyed remove what you can of them; the fire will remove the remainder. Many claim that an air space within a boiler wall is not of any service and the same thickness of brick would be better and the wall stronger.

Deep ash pits are the best, and a second or ash grate will help preserve the grate proper, as there is less refraction of heat from it than there would be from a hard brick bottom. The bars of a furnace should be 18 or 20 ins. below the boiler or crown of the furnace. They should slope downward toward the back part about one half inch to the foot.

There is one object that requires very particular attention, and which must be of a certain size to produce the best effect, and that is the flue leading from the boiler to the chimney, as well as the size and elevation of the chimney itself.

The fire-clay mortar is generally used as follows: one part fire-clay to two parts ground or powdered old brick or refractory sand. The brickwork about the boiler-setting is often imperfectly laid. It is generally done by contract, with no one to supervise it who understands the severe test to which it is to be put. The brick-layer, who may never have worked on a job of this kind before, builds good inside and outside walls, but the space between is apt to be filled up with odds and ends in the most promiscuous manner. Furthermore, he puts the same joint in that he would use if he were building a house, and this is just what we do not want in boiler-setting, particularly in the fire-brick lining of the furnace.

The joints throughout the entire wall should be very thin, and the work should be done as faithfully inside as outside. The fire-clay mortar used in the work should be used as thin as possible; in fact, some mill owners will not let a trowel be used in laying fire-brick, but require the mortar to be so thin as to necessitate the use of large iron spoons. The fire-brick should be dipped in water as they are used, so that when they are laid they will not immediately soak up all the water in the mortar. One point to be kept in mind constantly is to use as little fire-clay as possible in laying fire-brick under any circumstances.

Every sixth course, beginning with the grates, should be a row of headers *well bonded into the masonry behind.* The headers are of little use unless securely bonded into the main wall, for where the lower courses of fire-brick have burned away more or less, we have to rely on their headers, to a considerable extent, to hold the front of the wall in position.

In repairing fire-brick linings, the lower courses, which burn out fastest, can be removed and replaced without disturbing the upper part of the wall, provided the headers are secure, while, if they are not, the entire wall may have to be rebuilt, and this cannot be done without either removing the boiler or tearing down a considerable part of the setting or back wall. Those who have had considerable experience in repairing boilers claim that headers should not be put in until the lining has been carried up nine courses above the grate.

The setting of a horizontal boiler is a matter that almost any competent mason may accomplish, either for heating purposes or for power, by following these instructions and the examination of the *setting* of a boiler in place.

When upright boilers are enclosed in brickwork for heating purposes the outside is generally built square, to suit the door castings and for appearances; but the inside is generally built *round*, 3 or 4 ins. from the boiler, to make a flue or air space, which will be the same distance from the boiler on every side. If it is necessary to have a flue so constructed, with the outside still square, build two walls, — a round one and a square one, — but the inner one must not touch the outer one, or the latter will crack, in consequence of the contraction and expansion of the inner wall caused by heat.

SUGGESTIONS FROM AN EXPERT.

In an interview with Mr. William Peck, of the H. Wales Lines Company, Meriden, Conn., an authority on mason construction, we gained the following information: —

Do you favor the first or second setting of cements for mason work?

"That depends," answered Mr. Peck, "upon the work I have in hand. Generally, however, I prefer the second setting. The truth is that masons very seldom use the first or even second setting of cement, but, owing to their ignorance of the action of cement, generally use it in its third setting. Laborers usually mix up a bed full at a time and temper it as it is used, sometimes once, very often twice; thus by the time it gets into the wall it is in its second or third setting.

"For sidewalks or cement floors I prefer the first setting, as it works better and does not become so spongy under the trowel."

What do you consider the best mode of putting down cement floors?

"I think the best manner to do a good job is, first, to have the ground underneath well tamped down and solid; second, to use screeds instead of strips to get the proper thickness of cement; third, to have help enough to keep putting down all the time and not have to wait between batches, thereby causing a break or joint between the settings which is liable to make a crack; fourth, to float the first coat or layer as little as possible, thereby preventing the rising of the sand to the top of the cement, and insuring a good bond between the rough coat and finish."

What is one of the common errors of contractors?

"One great mistake they make is in not keeping their walls properly covered during construction, especially in the winter. A few dollars expended for tar paper or canvas and the time required to cover them will often prevent hundreds of dollars' worth of damage by elements, and will not leave a dark streak there when construction is continued."

CRACKS IN BRICKWORK AND PLASTERING.

WHAT CAUSES THEM AND HOW THEY MAY BE PREVENTED.

BY A. H. DYER.

(*Continued.*)

In Fig. 10 we have a case similar to that shown by Fig. 8, and an exact representation of the present condition of a certain store front; the opposite corner of this building is in the same condition as the one shown. By the location of the crack extending downward and outward from the window sill, and also crack G below the end of lintel, it would appear that the lintel had a bearing of only about one third the area of the 16 in. pier. Crack G extends entirely through the outside course of brick, but to what further extent could not be determined. It is quite probable, however, that the lintel has a bearing several inches outside of the crack G, and that a slight sagging of the lintel allowed the main part of the pier to be thrust outward as the unequal settlement of the foundation increased, and that this part of the pier again caught the entire load after that part of the pier at the left of crack G had been split off. This would not be likely to occur unless the ends of the lintel were set upon an uneven bed, leaving the extreme ends entirely or nearly free from the pier. The front being 48 ft. wide, the "I" beams, if securely bolted together in the center, and set in extreme hot weather, might possibly contract enough at the right time to slightly aid in causing crack G. Crack H is a very common occurrence, while crack G is not. Crack I usually appears after crack H, and when both of them appear and extend from the opening to the corner of the building they do not by any means increase the value of the building, or its reputation as a safe one. It might be well to add that the building described in Fig. 10 is in a town having no building laws or inspectors, but it is quite unnecessary to say that the foundation was built in the *good old-fashioned way* with just as large an area of footings per lineal foot below line A as below any part of the side walls.

Fig. 11 shows a stone door sill broken by continued unequal settlement, and is not an uncommon occurrence. Even if the sill was only bedded at the ends and "pointed up after completion of the brickwork," a bad case of unequal settlement would cause the sill to be broken as shown.

Fig. 12 shows the usual course taken by cracks that occur over a flat arch. It is a noticeable fact that over a segment or a flat arch the cracks usually work toward the center line of the opening, while in semi-circular arches they more frequently work *away* from the center line.

Fig. 13 shows a case that is not very common, and one that will require careful study to understand, but the cause is in the foundation, just the same.

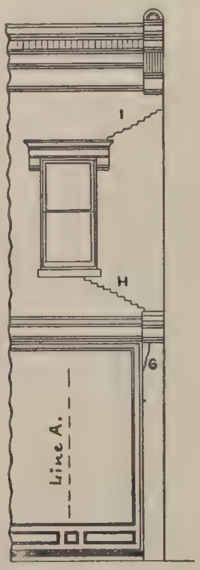


FIG. 10.

Fig. 14 shows a section and part elevation of the wall of a two-story and basement brick building; width of footings, 32 ins., basement wall, 16 ins., and wall above basement, 12 ins. thick. Now we will proceed to ascertain how many square inches of bottom footings should be omitted below the center of the openings in order that the foundation may have a uniform load per square foot or inch. In order to be more easily understood, as well as to avoid a complication of loads, we will at first assume that this wall is a portion of an end wall of the building and has nothing to support but the weight of the wall itself. First, we will take one lineal foot of the solid wall its entire height (which is 40 ft.), and find the load per square inch. At 112 lbs. per cubic foot, one lineal foot of the solid wall, including footings, will weigh about 4,910 lbs. Directly beneath this lineal foot of wall we have 384 sq. ins. or footings (12 ins. by 32 ins.); therefore, the load per square inch would be 4,910 lbs. divided by 384 sq. ins., which would be approximately a load of 13 lbs. per square inch. With a box window frame, the increased width of the inside of the opening will take out enough brickwork to offset the weights of the frame, sash, weights, etc., so we will figure the openings at the outside measurements as marked on the drawing, and we have a total of 8,101 lbs. that has been omitted by the three openings. Divide this by 13 lbs. per square inch, and we find that 623 sq. ins. must be deducted from the footings in order that they may have a uniform load. Now divide 623 by 32 (the width of footings) and we have approximately 19½ *lin. ins.* of footings more than is required to support the weight above at the rate of 13 lbs. per square inch. This 19½ ins. must be entirely removed from below the center line of the openings as shown, and the result will be practically a uniform load upon each square foot of footings. Now we will assume that Fig. 4 represents a section and part elevation of the *side* wall of a building, and that the weight of the floors, ceiling, roof, etc., that is distributed along the entire length of side wall, amounts to 7 lbs. per square inch added to weight of wall at 13 lbs. per square inch, which would make a total of 20 lbs. per square inch.

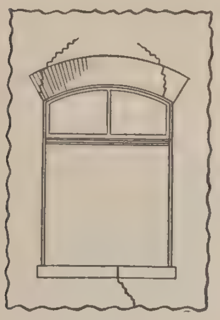


FIG. 11.

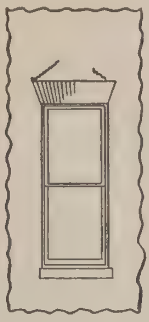


FIG. 12.

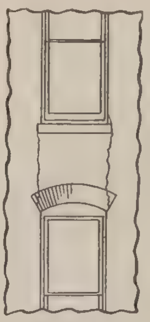


FIG. 13.

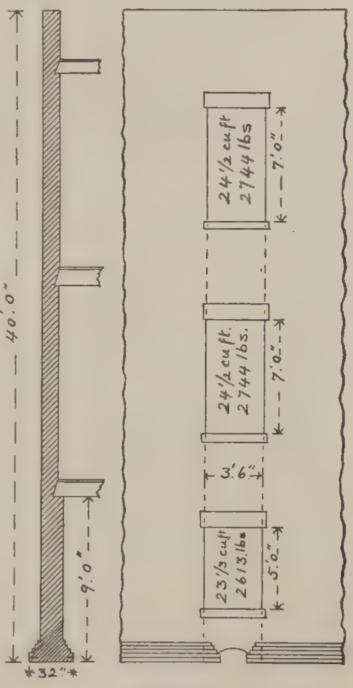


FIG. 14.

We will not go into any unnecessary details in regard to the exact spacing of the joists, etc., but will assume that this extra weight is evenly distributed. By calculating as before, with the exception, that we use 20 instead of 13 lbs. for the load per square inch, we find that the "cut out" in this case would be but 12⅔ ins. wide, instead of 19½ ins.; but, if we wish a perfect foundation it should be cut out just the same. It must be understood, however, that there are cases where the sides of the "cut out" would be too close to the center line of the openings, especially if the bottom opening were a wide one, or if located but a short distance above the footings; in such an event, it would be necessary to *increase* the width of the "cut out," and correspondingly increase the width of the footings at each side of the "cut out," as will be explained later.

When buildings that are built upon a continuous foundation begin to show signs of unequal settlement, as in Figs. 1, 8, 10, 11, or 12, the cracks can usually be prevented from extending any farther, by *relieving the footings*, and can even be "set back," or, in other words, the footings may be cut out so as to cause a *very slight* settlement toward the center of the openings; but in either case, no one but an expert should be allowed to make the attempt, and *he* should carefully consider the following points: —

First, the nature of the ground below the openings, as well as at each side of the openings. Second, the loads per square inch. Third, the starting point of the cracks, also the direction they seem inclined to follow. Fourth, the age of the building, and the manner of its construction.

Many a building might be saved from a bad reputation and consequent decreased valuation, if at the proper time the proper person was consulted and given the entire charge of the work. The right man *at the right time*, and with nothing but a plumb-rule, a piece of chalk, a pinch-bar, and a fair knowledge of mathematics, added to long, practical experience and good judgment, could, in a short time, prevent a great deal of trouble, and that, too, in a quiet way without attracting attention, and in most cases at comparatively little or no expense, except for *knowing how*, and in consideration of the benefits to be derived from a successful operation the latter item should not be too grudgingly considered, as *experiments* might prove to be still more expensive.

(*To be continued.*)

THE SUCCESSFUL BUILDER.

ONE can usually distinguish the successful builder by his pronounced characteristics; he possesses that firm, self-reliant appearance which denotes grit, patience, and energy, and stamps him at once as a person not easily discouraged or depressed. He is one of those individuals who seems to have the power to size you up at a glance, — a ready reader of human nature. You observe in all his actions the predominating elements of caution and conservativeness. We often find him a man possessing a somewhat limited education outside of his particular line; his opportunities of securing an elaborate education were necessarily very limited, as he probably took up his trade at the tender age of fifteen or sixteen years. But in the lesson of life he has proved an apt and diligent scholar, and through this training he has discovered, as pertaining to his calling, the fundamental principles of success; his brain is a storehouse of practical knowledge, and his men are the tools by which he puts this knowledge into practical execution.

Again, we often find him a man whom the world calls stubborn, very set in his ideas and opinions. He is generally a hard worker, and, if he be permanently successful, a natural financier. You might ask why these numerous qualifications are so potent a factor to the builder's ultimate success. Why must he be possessed of grit, patience, energy?

There is probably no business, trade, or calling which is at times so annoying, so discouraging, so disagreeable as that of a builder, and to overcome the difficulties which are bound to beset him under these conditions and circumstances it requires the exercise of all these qualities to the highest degree.

A single mistake or error in judgment, be it ever so trifling, may and often does result in the loss of hundreds of dollars. We must admit that mistakes will occur even under the best of management; but, once made, the builder or his superintendent must not proclaim their error to the public, or even to the workmen employed on the building, but must set to work at once to rectify it. As a reader of human nature he is often an expert; years of contact with his fellow-men in every class have developed this element in his character to a high degree. He must be able to judge of a man's ability at sight, and often at a glance he is able to discern their good or bad qualities, as the case may be.

Touching his education, we have reached, perhaps, and we say it with all due respect, one of the weakest points in his armament. How often, in the varied career of almost every builder, has he felt the need of a better education, especially in those branches which his business requires a thorough knowledge of.

With the assistance of such an education he could much more easily meet and overcome the problem of his calling and lighten those tedious hours of labor studying out plans and estimating on their execution, work far more irksome to him than working on the wall.

Ten or fifteen years ago the chances of securing the necessary education were slim, indeed, but to-day, with the facilities which are placed at his command at a comparatively small cost, and with the constant cry being for better trained men, is it not the duty of every up-to-date, practical man to avail himself of every opportunity, and thus advance himself and his craft?

One of the essentials in acquiring a better education is to follow current literature which has a direct bearing on one's business. To this end the better class of trade journals devote their entire energies, and it is beyond question that the artisan or tradesman who closely follows that particular journal which is devoted to the interests of his business is better fitted to successfully meet the problems which will arise so frequently and persistently.

In this connection, we would state that it is the purpose of The Brickbuilder, through its Masons' Department, to meet just these requirements of the *coming* contractor.

In our efforts to place at his disposal that class of matter which shall be of the greatest benefit to him as a means of better education, and to bring him into closer touch with the higher ideals of his work, we ask of him cooperation and support.

HEADERS ALONG THE LINE.

Bricklayers are in demand throughout Connecticut, and the outlook is for steady work for several weeks.

Masons should take great care in laying terra-cotta blocks or ornaments; otherwise the long lines of a building, such as the string-courses or cornices, which are intended to be straight, are apt to be uneven, and the faces of blocks often winding.

The latest building accident is the collapse of the Coliseum Building, Chicago. This vast hall was to cover five acres of ground and seat 16,000 people. Better by far it should fall now than when filled with human lives. Now the question is, Where does the blame lie?

The propriety of using mortar joints as thin as possible in brickwork is urged by the best authorities. In Roman and most Eastern work the joints in some instances were 1 and 1½ ins. thick, and when the mortar has been good such buildings, after centuries of wear, have been found sound and good but we have no such faith in mortar made in modern times. Mr. Rawlinson says, "As a general rule, buildings, whether of marble, limestone, sandstone, or of brickwork alone, or of brick and terra-cotta combined, which are ornamental in character, must all have *thin* joints. Thick beds and joints of mortar would destroy the harmony of design by deteriorating the appearance of labor bestowed on the rich material in such buildings."

American workmen engaged in building construction are inclined to think, in view of the recent disastrous collapse of several large structures in course of construction in this country, that their position is far more hazardous than that of their foreign brethren engaged in similar occupation. We find, however, that this idea is entirely erroneous, as will be seen by the following reports sent to this country.

Three weeks ago a building in process of construction in Guben, a city of Brandenburg, collapsed, burying sixteen workmen in the ruins. Nine of the men were instantly killed, and the others severely injured. Again, about a week later, a spinning factory at Bocholt, in Westphalia, fell down, burying forty men, ten of whom were killed outright, while nine more were seriously injured.

A number of architects who are in sympathy with The Brickbuilder's efforts to bring the mason into closer touch with the architect will contribute to this department during the coming year.

LEGAL POINTERS.

Construction of Building Contract as to Alterations. — A contract provided that the builder should forfeit ten dollars for each day that the building remained unfinished after the time fixed by the agreement for its completion. It also provided that any change in the plans, "either in quantity or quality of the work," should be executed by the builder, "without holding the contract as violated or void in any other respect." During the progress of the work a change was made in the material for the front of the building, from brick and granite to Indiana stone, with carved panels and frieze. The difficulty in procuring a prompt delivery of the stone caused delay in finishing the building, and the owners claimed to recoup the stipulated forfeit and set off the loss of rents. By the agreement the owners reserved the right at any time during the progress of the work to make any alterations in the plans and specifications, and it became the duty of the builder to carry them into effect. The provision that the changed plans should be executed without holding the contract as violated or void in any other respect should be read in connection with this reserved right. The words "in any other respect" exclude the implication of any change in terms except such as would result from the alteration of the plans, but not such changes as would be the necessary consequence thereof. Alterations calling for more work and materials might, of necessity, require more time for the completion of the building. They might be directed so near the end of the work as to make it impossible to complete the building within the time stipulated. In this case the building was located where the material fixed for the front by the contract could be purchased in an open market and delivered ready for use in one day. The stone required by the alteration could be procured only at the quarries in Indiana, where an order had to await its turn; and, after delivery, it required weeks of skilled labor to fit it for use in the building. For such delay in the completion of the building as was the necessary consequence of the change of plans by the owners the builder was not answerable, and for it no forfeiture could be exacted. —*Supreme Court of Pennsylvania.*

What is not a Party Wall. — Where one, intending to construct a wall for his building within the line of his lot, by mistake extends the foundations slightly onto an adjoining lot, the wall does not for that reason become a party wall.

The party constructing a wall so that it projects for an inch and a fraction onto an adjoining lot may be compelled to remove it, so that it shall not encroach. Parties have no right either in law or in equity to occupy land that does not belong to them. — *Supreme Court of Pennsylvania.*

Breach of Building Restrictions. — A roofed porch, built on brick foundations, and permanently attached to the whole front width of a house, though unenclosed, is within the prohibition of a building restriction in a deed that all buildings shall be erected not less than a certain number of feet back from the fence line.—*Supreme Court of Pennsylvonia.*

Release and Discharge. Joint Contractors. — Where a person who is liable to two or more on a joint contract settles with one of them for a part of the claim, such settlement does not discharge him from the liability to the others, but they may sue for their part without joining the one settled with. — *Supreme Court of New York.*

The Supreme Court of Pennsylvania holds that the owner of a building cannot complain of an instruction in an action to enforce a mechanic's lien restricting a material man's recovery to the value of the materials furnished by him on the credit of the buildings, and actually used in their construction.

Damages for Delay.— Where a contractor fails to complete a building, and the owners take possession and do so, the measure of damages will be the amount of the unpaid contract price, less the fair and reasonable amount the owners had to pay to complete the work.

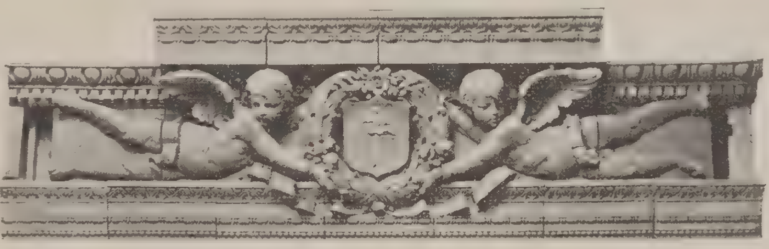
Recent Brick and Terra-Cotta Work in American Cities.

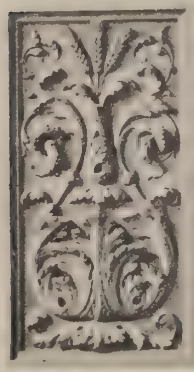
A Department Devoted to the Interests of the Manufacturer.

PHILADELPHIA.—"Unless all signs fail," Philadelphia will, within the next few years, witness the erection within its borders of several buildings which will be handed down to posterity, buildings which will be erected to last for centuries, and to show to future generations the achievements of the present in art, architecture, etc. We refer to the buildings now in preparation for the Archæological Society of the University of Pennsylvania and the Art Museum about to be erected in Fairmount Park by the park commissioners of the city of Philadelphia.

The former project has lately assumed definite shape and will be pushed to completion as soon as a small grant of property is made by the city council to the Archæological Society, in order to enlarge the now irregular plot to the dimensions required for the proposed building; this grant, it is understood, will be made at once, so that the work upon the western section can be commenced.

The building, when completed, will be 700 ft. long and 525 ft. deep. It will consist of a large central pavilion, surmounted by a dome, and flanked on either side by a smaller pavilion and dome; from this central pavilion six arcaded passages lead to the buildings set apart for the different departments represented in the society; there will be in all nineteen pavilions, all connected to each other, and to the central portion by the arcades, and all facing upon the large, open gardens which will surround the entire building; the buildings will all be terraced to the central pavilion, which will be about 12 ft. higher than those fronting the grade of the streets, and will enhance very much the artistic and monumental features of the scheme.





The material for the entire buildings will be brick; wherever it is possible to use bricks they will be preferred to other materials; very little terra-cotta will consequently be required, and this only where bricks will not fully meet the requirements; the kind and color of the bricks has not, as yet, been determined, but will be in the near future; the cost will be about $1,500,000, and the part of the scheme which will be pushed to completion in advance will, it is estimated, cost about $300,000.

Architecturally, the project could not have been put into better hands. Messrs. Cope & Stewardson, Frank Miles Day & Bro., and Wilson Eyre, Jr., have been associated upon the work; and any one familiar with their work knows that, with such a combination of the best talent in the city, the artistic as well as the architectural features of the building will be well rendered throughout.

Several sketches, principally of the massing of the different parts of the work, have been made and some published in the daily papers, but, as the scheme is still being studied and changes being daily made to it, we refrain from publishing any of the sketches until the entire scheme is completed.

Architectural interests are at the present time centered upon the competition for the Art Museum for Fairmount Park, which closed on the first of this month; probably there were no more surprised persons to be found than the commissioners themselves when they saw being delivered to them 111 designs and some alternatives (one architect, we believe, sent in nine different schemes), mostly mounted on stretchers of such immense size that there was no place to put them, and some of which would not go through the door into the room where they were to be temporarily stored. They did the best thing they could, sent them out to the park and placed them in Memorial Hall, where they will probably remain until finally judged.

The designs come from most of the largest cities of the United States, some from Canada, and one from Paris. Nearly every large city is represented by one or more designs, and it is probable that, although the terms of the competition were very vague and unsatisfactory, much real good work from some of the best architects in the country has been submitted.

The commission having the matter in charge held a meeting at the Memorial Hall recently, and the subject of having expert and professional judges pass upon the merits of the designs was freely discussed; a resolution was passed, which will soon be submitted to the park commissioners for ratification. It provides for a committee of experts as follows: —

"The provost of the University of Pennsylvania.

"One person selected by the directors of the Academy of Fine Arts.

"Three disinterested architects.

"Two expert builders, not architects, chosen by the Memorial Hall committee.

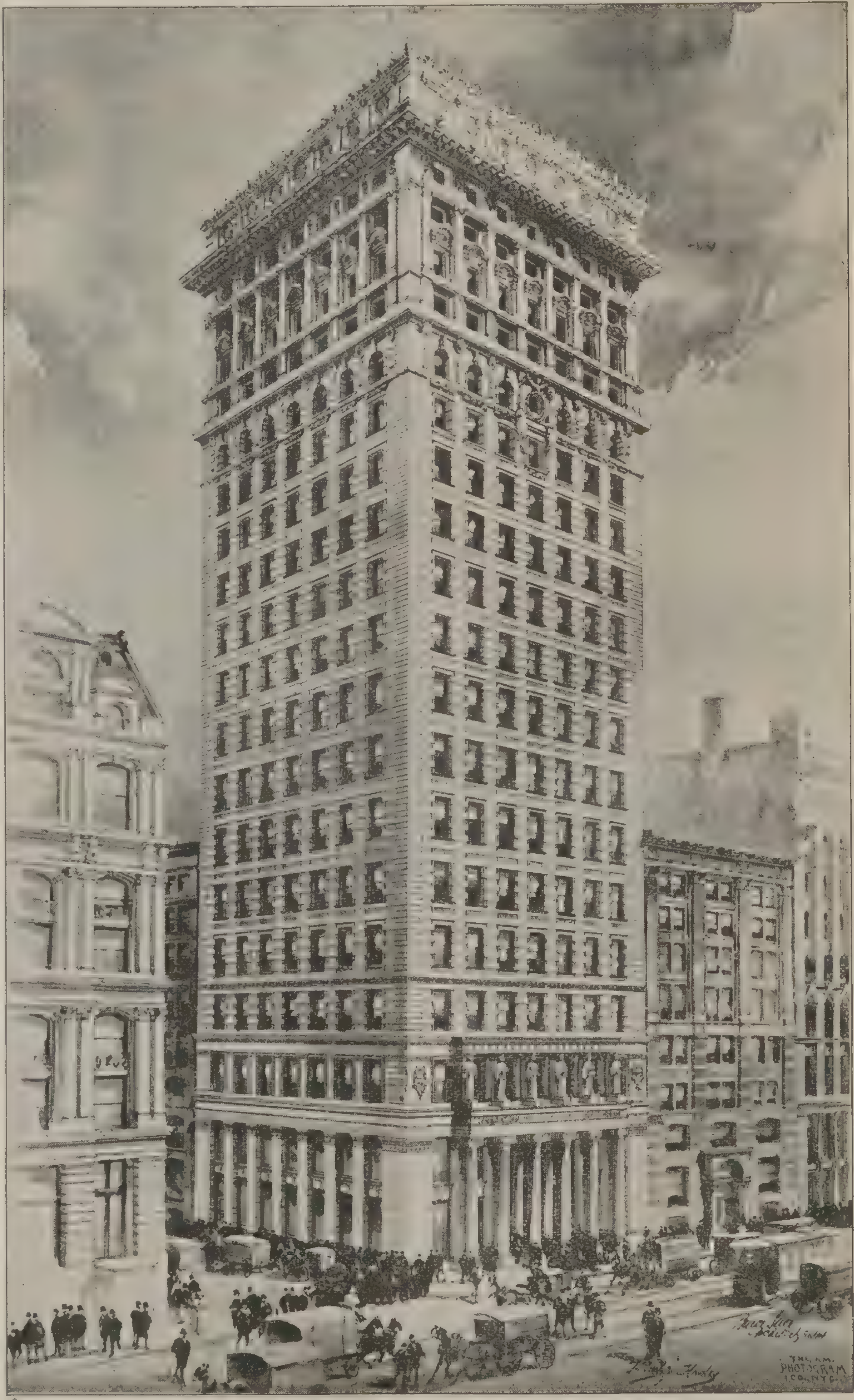
"They shall meet and examine the designs, and report on or before Nov. 30, 1895, for the determination of the board of park commissioners. Eight of the designs entitled in their judgment to be candidates for the prizes offered."

The result of the deliberations of the judges will be awaited with considerable eagerness by the entire profession. It seems not improbable that the result of this poorly regulated competition will be more satisfactory than those in some of our neighboring cities, which were supposed to be conducted upon a more favorable basis, so far as the profession is concerned.

THE accompanying illustrations are of terra-cotta details for the new Horticultural Hall and several fine residences now being erected in this city. The details have been finely executed by the Conkling-Armstrong Terra-Cotta Company.

THE Chisholm, Boyd & White Co. makers of the well-known Boyd Brick Presses, have removed their general offices from 324 Dearborn Street to the company's works, Fifty-Seventh and Wallace Streets, Chicago. Like many other large corporations with extensive plants, they have found it desirable to concentrate their entire executive force under one roof.

CHICAGO.— One of the outgrowths of labor unions is the attempt on the part of contractors to limit the number of recruits to their ranks. Perhaps it would be better to say that their object is to keep out unworthy men, — an object which physicians and lawyers attain by means of state licenses, — a means which, by the way, ought to be in the hands of the architectural profession, as well. In the case of a contractors' association they can scarcely be blamed for using their relations with labor unions to keep men from working for a contractor who is not one of their number, if through such means (by stopping the operations of a would-be contractor who lacks skill in his work or honor in his dealings) they can prevent a lowering of standards of workmanship and prices. But anything beyond that is certainly subversive to the rights of free citizenship. The Masons' and Builders' Association, of Chicago, is exciting a little talk in this connection. A certain gentleman, who had a large general contract on hand at the time, was invited to join the association. He responded by putting in his application, and then was blackballed. It is reported that then a decree was issued that he would be allowed to finish his existing contract, but that he must enter into no others. At any rate, whether such warning was given or not, the gentleman, who has high qualifications for his business, considered it wise to make the best possible preparations for a legal fight for his rights. Centralization of power, either in the case of capital or labor, brings dangerous temptations.


THE AM. PHOTOGRAM CO. N.Y.C.

AMERICAN SURETY COMPANY BUILDING, PINE STREET AND BROADWAY, NEW YORK.

Bruce Price, Architect; C. T. Wills, Builder; twenty stories high; foundation, 72 ft. below curb; height of building, 306 ft. above curb; frontage, 84 ft. 8 ins. on Broadway, 85 ft. 6 ins. on Pine Street. Brick furnished by Sayre & Fisher Company.

Another high office building is on the boards, but full announcement of it cannot be made as yet.

Apartment buildings costing from $5,000 to $75,000 each continue to astonish by their numbers. One costing $200,000 for Mr. O. E. Weber, E. H. Turnock, architect, is to be built on Prairie Avenue, in a neighborhood of fine residences. It is to be fire-proof, tile floor and steel beam construction, and cast columns (alas! that steel scarcity should crowd out rolled columns in favor of more easily obtained cast iron). The plan arranges to have teams drive directly into the basement, whence supplies are carried by elevators to the sixty-four different suites.

The *Economist* announces a project to build on North Clark Street an elaborate ten-story apartment building, fronting 300 to 400 ft. on each of two streets. This is still a scheme.

In the way of manufacturing buildings some large new bicycle factories as well as additions to old ones are being built.

The courts and other tenants of the old Federal Building are preparing to find quarters in various office buildings. The post-office cannot move into the temporary building at the expected date. The time limit (ten weeks) is about up for the completion of the temporary post-office, which will be a very neat, common brick and wood construction building, with wood grillage foundations. From present appearances, the $100 per day penalty for delay will have a chance to pile up considerably.

The announcement that Mr. Chas. A. Coolidge is likely to be appointed architect for the new permanent Government Building certainly brought sighs of relief to Chicago architects, who feared that the work would fall into worse hands. The only objection made to Mr. Coolidge worth noting is that he has not lived here long enough to be a real Chicagoan.

The local chapter of the A. I. A. has elected new officers as follows: President, George Beaumont; Treasurer, L. G. Hallberg; Secretary, Dwight H. Perkins.

The American Terra-cotta Co. has the contract for the terra-cotta for the new Davies office building (Jenney & Mundie, architects.) This is one of the buildings where, to avoid delay, cast iron instead of steel columns will be used.

DETROIT. There is no change of note in the general business situation, and the conviction is steadily gaining ground among dealers that the present fall will see a decidedly lively market.

The volume of trade is equal to that of last year, and in some important branches is larger than that of any other year.

The real estate transactions which benefit the builders at large are sales of vacant lots for improvements, and in this respect Detroit can make as good a showing as any city of its magnitude in America.

Members of the site committee of the board of supervisors now favor purchasing the Henkel site property at a cost of $500,000 for the new county building. The committee met last week with the county auditors to discuss the question of who should have charge of the erection of the county building, and it was at this meeting that Mr. Baker gave the opinion that it would be advisable to offer prizes for building plans, as follows: First prize, to use plans for building; second prize, $1,500; third prize, $1,000; also that $500 be divided among the remaining plans of merit.

MANTEL EXECUTED IN FAIENCE BY THE ATWOOD FAIENCE COMPANY.

A number of Eastern capitalists have had agents in Detroit the past week looking over the city with a view of making investments. They have finally decided that the best investment at present is in office buildings, and a number of deals are on that will lead to the erection of some more mammoth sky-scrapers.

Arrangements are on foot for very important improvements on Virginia Avenue, which will make that thoroughfare one of the most attractive in the city. The avenue has already been paved with brick from Woodward to Second Avenue, and fine residences of brick, costing from $10,000 to $15,000 each, are to be erected for Lincoln Abraham, Alexander H. McDonald, Rev. W. Warne, and three by Tuller & Van Husan.

Geo. F. Case, proprietor of the livery stables recently destroyed by fire, will rebuild. Plans are now being prepared by his son. Building will be 50 by 100 ft., five stories high, and be of fire-proof construction; cost, $25,000.

Architect William S. Joy has prepared plans for a handsome apartment building for W. T. McGraw to be erected opposite Ferry Park. It will be constructed of pressed brick with stone trimmings, $21,300.

John Scott & Co. have prepared plans for a fine residence for Alfred E. Bonsfield. It will cost about $20,000; proposals are now being received for its erection.

Another flat is being erected by Frank D. Hovey, on Selden Avenue. It will be of brownstone and buff pressed brick, six stories in height, and will cost $62,000.

Charles Bath will build a block of residences, 104 by 54 ft., constructed of brick and costing $50,000.

There are also a number of manufactories about to be built in Detroit, most of which will be constructed of brick.

Architects Malcomson & Higgenbotham are preparing plans for a schoolhouse, 85 by 125 ft., and containing twelve rooms. It will be built of buff brick.

ROCHESTER.— Building has improved but little, if any, since last month. What work is now on is mostly such as the architects do not care to announce. Many of the architects have designs out for buildings which will go on next spring, but very few have anything which will be built this fall.

Messrs. Kelly & Headey have let contracts to White & Coughlin for the erection of a church at Ovid. New York Hydraulic-Press Brick throughout.

Mr. Geo. T. Otis is having plans figured for the First Presbyterian Church at Mendon. New York Hydraulic-Press Brick will probably be used.

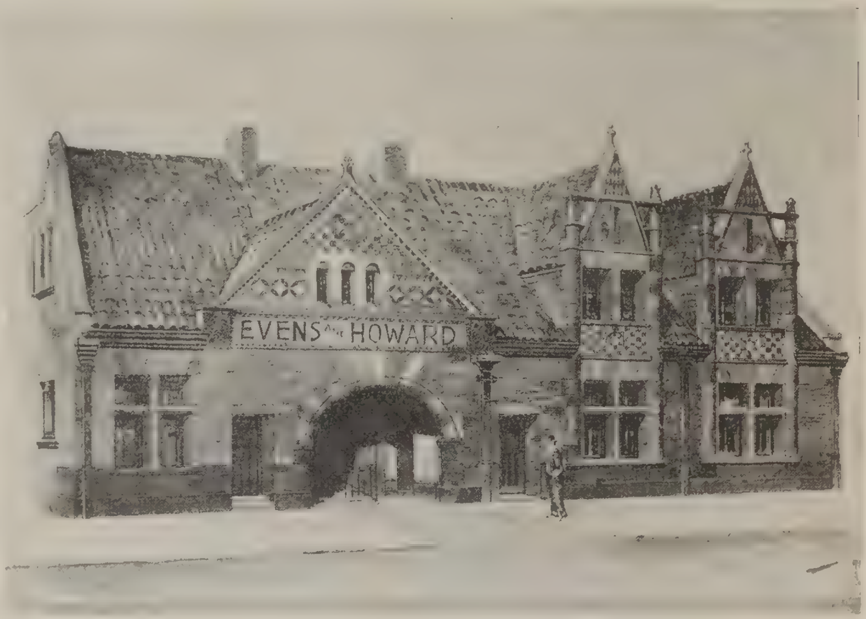
Messrs. Fay & Dryer are preparing plans for a large residence; pressed brick and all improvements.

MINNEAPOLIS.— Building operations continue with us on a rather extensive scale and bid fair to continue until winter sets in.

The architects, generally, are not busy as they would like to be, as most of the work is of a small character requiring nothing special in design. This has been a "banner" year in the building of homes, the number of these being highly gratifying, as indicative of the general desire to build and own, instead of renting houses. It promises well for our future.

There is a noticeable hesitancy about beginning building enterprises that will take several months to complete. We have good cause to believe that next spring will find us as busy, generally, as we could wish.

We have had two large fires during September, Westminster Church being completely ruined beyond repair, and the Chamber of Commerce being unroofed and considerably damaged internally. Both of these fires have been traced to electric wires, showing the great necessity of care and frequent inspection of these dangerous methods of lighting. The church will probably be rebuilt in another location, as soon as insurance is adjusted, the present location being extremely valuable for business purposes. It is also possible that the "Chamber" will be rebuilt on a larger scale, as the present building has always been too small to accommodate the principal grain market in the Northwest.



OFFICE OF EVENS & HOWARD BRICK COMPANY, ST. LOUIS, MO.

These two buildings will give a great deal of employment during the winter and spring.

Among the buildings contracted for and under way may be mentioned :—

Astronomical observatory for State university, 22 by 40 ft., built of local brick and stone. C. R. Aldrich, architect. Cost, $10,000.

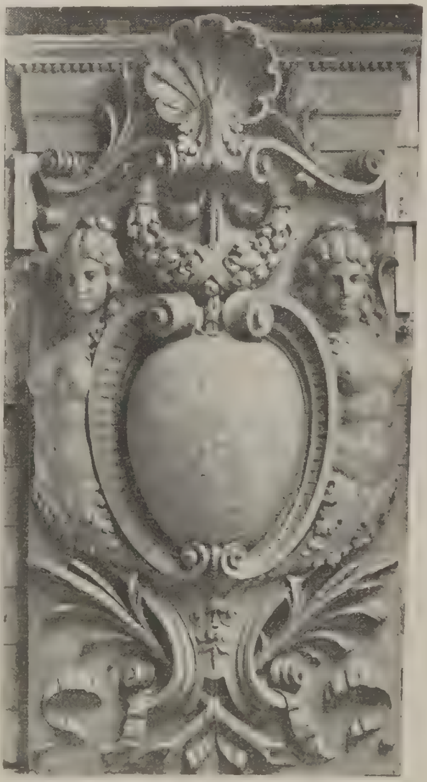
Drill hall and gymnasium for university, 128 by 244 ft., three stories, pressed brick and stone, slate roof, seating 4,000. Cost, $75,000; same architect.

Business block 50 by 100 ft., four stories and basement, for Mrs. Geo. Hale. McMullen Brick Co.'s pressed brick, with brownstone trimmings. Cost, $25,000.

Two-story warehouse, 117 by 130 ft., for Josiah Thompson; pressed-brick facings. Cost, $20,000. Wm. Channing Whitney, architect.

Baptist Church at Vandalia, Ill., 60 by 100 ft., pressed brick, stone trimmings. Cost, $10,000. Architect, Warren H. Hayes.

Double flat building, 78 by 106 ft., three stories and basement, twelve apartments complete, red pressed-brick facing. Cost, $40,000. Wm. S. Hunt, architect.



TERRA-COTTA DETAIL USED IN GERKEN BUILDING, NEW YORK CITY.

Furnished by Meeker & Carter, agents for the Staten Island Terra-Cotta Company.

MESSRS. EVENS & HOWARD have made a departure from the ordinary building methods in the construction of their city offices, 920 Market Street, St. Louis, illustrated in the accompanying cut.

This company has long been engaged in the manufacture of retorts and other apparatus requiring the use of fire-clay slabs and other shapes of large size which, in burning, receive every conceivable shade of color ranging from a bright shade of yellow through reds and browns to blue and black.

Hence, when Architects Eames and Young were called upon to design this building, it was a natural suggestion that if large and solid pieces of clay could be successfully burned as was proved by the material lying in heaps in the company's yards, there was no good reason why the sill courses, lintels, and other trimmings of the building could not be manufactured in the same manner. Therefore, in designing this building, a Romanesque motif was decided upon as best calculated to display the characteristics of this new material and afford a better opportunity for the production of color effects in the wall surfaces.

No stone has been used, but all parts of the building, except floors and necessary metal work, are burned clay blocks in various forms.

The plain wall surfaces are of Roman brick, and the trimming entirely of this material, which differs from ordinary terra-cotta in that the various members are burned solid; becoming dense and hard as stone, impervious to water, and not subject to injury from the action of frost or fire.

No color drawing can adequately portray the richness and variety of tint which this material takes on, and while the effect of the present building is injured somewhat in its being surrounded by high and dingy walls of common brick, and is on a business thoroughfare, it requires but little of the artistic sense to imagine the charming possibilities of its use, when possible to take advantage of the contrasting colors of trees and climbing vines.

With none of the precise sharpness of stone, it has an advantage over it which makes it particularly valuable for country house work. It requires but a glance to convince any architect endowed with the color sense that it is a most welcome addition to our somewhat limited list of artistic building materials.

THE superior quality of the roofing tiles made by the Celadon Terra-Cotta Company, Charles T. Harris, Lessee, is finding deserved recognition at the hands of many of our leading architects. Contracts to supply these tiles have recently been closed for the following prominent buildings: Robert Goelet's Hotel Walton, Angus S. Wade, architect, Philadelphia, Pa.; Chicago & Alton Station, Springfield, Ill., S. S. Beeman, architect; Third Presbyterian Church, Chester, Pa., Isaac Pursell, architect; Trinity Memorial Church, Binghamton, N. Y., Lacy & Bartoo, architects.

PERHAPS there is no more insidious menace to health than the poisonous fumes of sewer gas. These are the more dangerous because the greater part of them are not detectable by odor, and too often their malignant presence becomes known only through their harmful effects upon the health of those brought in contact with them.

VOLVME IIII NOV. 1895 NO·11

THE BRICKBVILDER

OFFICE 85 WATER STREET BOSTON

THE BRICKBUILDER.

AN ILLUSTRATED MONTHLY DEVOTED TO THE ADVANCEMENT OF ARCHITECTURE IN MATERIALS OF CLAY.

PUBLISHED BY

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FIRE-PROOF construction in this country may be said to have had a spontaneous and quite recent creation, due to commercial necessity rather than constructive choice. As a nation, we seem to prefer or at least be satisfied with wood as a building material for ordinary constructions, until a conflagration teaches us financial lessons which cannot be ignored. In other words, fire-proofing is an expedient with us rather than a fundamental matter of course. As a result, the systems adopted for the protection of buildings against fire have been largely of a tentative nature, and, with a few notable exceptions, there has been an absence of deliberate investigation on the part of our constructors which is quite noticeable. The present systems of fire-proofing practically arose as a result of the great Chicago fire in 1871, and when it is remembered that in the whole of New England there is, so far as we know, only one fire-proof hall of audience, and that outside of the larger cities a fire-proof structure is seldom even thought of, it will readily be appreciated that, though fire-proofing as a science has reached a point where it is upon perfectly firm ground, the construction itself is by no means universal. The public is apt to be skeptical on the subject of fire-proof buildings, chiefly, however, from ignorance. Whenever a large commercial building goes up in smoke the daily papers are sure to
out with reference to it as "another fire-proof building which
not fire-proof." The few actual tests of fire-proof materials
h were not made by parties interested in selling some particular
m of fire-proofing have been admirable in as far as they have
. In New York a joint commission has recently been appointed
ding some of the most prominent architects, constructors, and representatives of the city government, by whom it is hoped a series of practical and conclusive tests will be made to demonstrate the absolute resisting qualities of the various devices which are now in the market. It would seem to be quite within the scope of a municipality to undertake such works as these. Tests properly conducted with impartial judges would give an impetus to the fire-proofing industries such as they could receive in no other way, and would, besides, enable the building public to know what is in the market and what it is good for. It may truly be said, however, that, though the conditions governing the application of fire-proof construction are quite different in New York, Chicago, Boston, and Philadelphia, there is yet to be an instance on record of a structure which was thoroughly fire-proofed according to the laws of either one of these cities which has been materially injured by conflagration; and the reasonable inference is that, though our fire-proofing methods are still quite crude in detail and are limited in variety of applications, they are correct in principle. The outcome of the experiments which the New York commission will make will be watched with a great deal of interest. We ought to fire-proof our dwellings, as well as our public buildings, and when our constructors can look beyond the first cost, and consider more the ultimate endurance and capabilities of a building which cannot be consumed, it will not need the object lesson of a great conflagration or an expensive fire department to stimulate the fire-proofing industries to the devising of a system of construction which will be within the reach of all who build.

THE brilliant series of articles by Edward Weeks, the artist, which have been published in *Harper's Monthly* ought to be read with a great deal of very keen pleasure by every one who has had a hand in even the slightest attempt to introduce decorative features in color or in form into our modern buildings. The office building as a problem seems almost hopelessly removed from the Taj Mahal or the mosque of Futtipoor Sikri, and yet in a sense there surely can be some very valuable lessons drawn from these dream-like palaces, capable of being applied directly to our commercial structures, which, homely and uninteresting as they sometimes are, can, nevertheless, offer opportunities for external treatment which unfortunately we have been all too slow to grasp. If there is any department of building in which faience should find an appropriate expression it is in the modern office building, — a structure which is primarily made for use, which theoretically eschews every feature which will not last and keep clean, and which, at the same time, may, within natural limits, be made a thing of beauty. We all know the unsatisfactory results attained by color in any material which will hold a deposit of soot or dust, and although we would not say that the entire surface of a building could advisably be covered with enameled terra-cottas or faience, the highly polished material could certainly be used in places with very good effect. Probably nowhere in the world has color been used so lavishly and on the whole so successfully for external effects as in India; and, although we cannot put the glories of the Taj about the setting of an office building, we can get ideas from such beautiful, poetic coloring, which, if they could be translated through the medium of our modern faience into architectural forms, might easily introduce a revolution in public taste which would be very far reaching in its influence. We, as a nation, are afraid of color; we use it timidly or in an apologetic manner, chiefly because we don't know how; but the colored terra-cottas have certainly prepared the way for the more vivid colorings of faience, and, once started on the right track, there would seem to be no esthetic or commercial reason why our buildings growing up from a sober basement of stone or iron should not blossom out in the upper stories with a burst of color treatment which would be a fitting crown to the structure. It is better to be bold even to rudeness than to be merely timidly crude, and we hope some designer will arise with the courage to roll up his sleeves and give us some color treatment that will be real color and not mere application of colored material.

ONE of the indirect results of the use of the skeleton construction which has become so common in connection with building operations throughout this country has been to call attention to the inefficient manner in which ordinary brick buildings are secured against lateral motion. A case in point is a building about 90 by 60, built of brick, carried up through four stories, and with two lines of girders at right angles to the front of the building. The construction consists simply of posts superimposed upon one another with projecting iron caps carrying the girders of each floor. The floor beams are loosely tied together with iron clamps, but, although the walls run from 20 ins. in the first story to 16 ins. in the upper, the question of how strong such a building would be against a sudden jar sidewise is something which is not easy to determine. Probably, if the side wall could be started enough to get a little off its center gravity, the whole building would collapse like a pack of cards, and there would be another startling notice in the journals calling attention to such horribly bad construction; whereas, in reality, the building is constructed exactly on the lines of thousands of structures all over the country, and, were it not for the absolute necessity of lateral bracings which the skeleton construction has manifested, it is doubtful if any one would think of condemning such a method of building.

A brick wall, in the eyes of a great many builders, will stand about all that can be put upon it, and one seldom takes into account the limits of its resistance to lateral motion. We are pretty well informed at present upon the resistance of brickwork to vertical compression, but we know practically nothing of the lateral strength of a wall. In taking down a building recently in Boston, the walls were found to be some 3 ft. thick outside, but with two hollow spaces, the whole being so slightly bound together that when truss plates, weighing perhaps a thousand pounds each were lowered over one edge of the wall it was pulled out of plumb nearly 5 ins. It would seem as if it would be possible to make some experiments with the numerous old brick buildings which are being torn down nearly every day and ascertain by actual tests how much force would be required to throw a wall of certain thickness and height sufficiently off its center of gravity to cause its collapse. Such data is very seldom collected and would be of great value.

Suggestions in Brickwork, with illustrations from the architecture of Italy, together with a catalogue of brick made by the Hydraulic-Press Brick Company. — Although primarily a trade catalogue, this publication of the Eastern Hydraulic-Press Brick Company, of Philadelphia, deserves more than a passing mention for its intrinsic interest and excellence. It is certainly the most complete and the most suggestive brick catalogue that has come under our notice. We should not be at all surprised to see it produce a marked improvement in the architecture of small towns and outlying districts, East and West, which are somewhat outside of the sphere of influence of the large cities,— places to which the trained architect has rarely found his way. To the architect, also, this book of plates will be full of helpful suggestions. Besides the "catalogue of shapes," there are a series of excellent "suggestions in design," showing how these moldings may be applied in windows and doors, arcades, cornices, fireplaces, etc. All the designs shown are good. The pages are further embellished by a series of half-tone reproductions from photographs of the best Italian brickwork. These have been selected with excellent judgment by Mr. Frank Miles Day (to whom, doubtless, are to be ascribed, also, the suggestions in design), and add not a little to the attractiveness and value of the book. The company is to be congratulated on having been able to secure so excellent a designer to direct their enterprise. In the profiles themselves we notice some additions and some improvements. The square bonding brick and the great variety of panel-miters will be especially useful. Taken as a whole, the catalogue in all its essential features marks a most decided advance.

IN the William Connors competition the judges awarded the prizes as follows: First prize, Pierre A. Liesch, Boston; second prize, H. F. Lehr, Allentown, Pa.; third prize, Charles Wierbach, Allentown, Pa.; first mention, Charles Wierbach, Allentown, Pa.; second mention, James C. Green, New York City; third mention, Edwin R. Clark, Lowell, Mass.

The following is the report of the committee: —

TO THE EDITOR OF THE BRICKBUILDER: —

Dear Sir,— Although there were thirty-four designs submitted for the American Seal Mortar Color advertisement, the members of the jury, working entirely apart from one another, have arrived at the same opinion with regard to the placing of the three prize designs. These are as follows: —

The design marked S. P. Q. R. is entitled to the first prize. This drawing is good as an advertisement, and, what is more, good art. The lettering is clearly and carefully drawn, though the division of the word "easily" is incorrect. This, however, could readily be rectified, and, indeed, the spacing of the line below would then be bettered. Making the struts of the scaffolding appear in the drawing is a very ingenious and pleasing device, and the line throughout is uniformly excellent.

The design submitted by "James" for the second prize is distinctly inferior to the first design in every way, and lacks all of the interest which the first possesses; neither is it so well drawn, the ink being gray and the line poor; nevertheless, there is considerable ingenuity displayed in the form of the cartouche, although the lettering is brought too near the ends to be as conspicuous as it would have been had more margin been allowed. The floret at the top of the inscription is exceedingly bad, and the lions have no apparent reference to the subject. Nevertheless, there is a good deal of dash shown in the drawing, and it will more than hold its own with the other advertisements printed around it, without a doubt.

For the third prize the design marked "Sir Christopher." The figures in this design are good, though, if we are not mistaken, "Sir Christopher" has shown a lack of knightly qualities in using poses which seem so familiar, though we are unable to place their original positions exactly. The lettering, although of an irregular sort, is distinctly good. The strings of the lyre coming as they do against the frame surrounding the inscription is unfortunate, and might have been avoided. With less familiarity with the T square and more artistic feeling, the draughtsman would have slanted the lyre diagonally across the frame.

In addition to these prize designs, the jury commends for first, second, and third honorable mention the designs marked, "Sir Christopher" (2d), "A Mason's Trowel," and "Bay."

The effect of the ornament in the design to which we award first mention is very good, but would be much bettered by reduction. The lettering is, if anything, better than in "Sir Christopher's" third prize design, but the ink is gray, and will need careful process work.

The second mentioned design is extremely good and very clear, as also is the third. These are apparently by the same draughtsman, and there is little to choose between them, for, while "Bay's lettering is better drawing, the interest of the design marked wi a trowel is considerably greater.

It has been an easy matter in this competition to reach a result, for, while there are many clever drawings among the rest, there are none which artistically can compare with the above.

Respectfully submitted by
Bertram G. Goodhue,
D. A. Gregg,
R. Clipston Sturgis.

OUR ILLUSTRATED ADVERTISEMENTS.

A VERY successful ten-story office building is now approaching completion on Broadway, New York City, and of which Mr. John T. Williams is architect and building owner. The three first stories are of stone, the next five of terra-cotta and brick, and the two last are executed wholly in terra-cotta. A portion of the latter composition is made the subject of illustration by the New York Architectural Terra-Cotta Co., on page xxi. The color is a light gray so uniform in shade and so good a match for the Indiana limestone that it is difficult to draw a line of demarcation between them.

Unskilful and slovenly setting have always been and is still a grievous drawback to the complete success of terra-cotta work. It has often been the cause of adverse and unmerited criticism being directed against the material itself, however perfectly each block may have been made and fitted and delivered on the site. We take pleasure in noting that such has not been the case here, and that the care and forethought displayed in the setting and cleaning down reflects much credit on the men entrusted with these vitally important duties.

The adjoining capital and panel has been selected from among the details used on this building.

The subject for this month's illustration in the advertisement of the Celadon Terra-Cotta Co., Charles T. Harris (lessee), see page vi., is of the Pullman Memorial Church, Albion, New York; S. S. Beeman, of Chicago, architect.

In the new advertisement of Stephens & Co. (see page ix) is illustrated a panel executed in terra-cotta for the residence of Mrs. George W. Childs, Washington, D. C., of which Furness, Evans & Co. are the architects. The panel was modeled by Karl Bitter.

The Atwood Faience Co. show in their advertisement, on page xix, another beautiful mantel executed in faience.

IN the New York Architectural Terra-Cotta Competition for a design for a full-page advertisement the judges awarded the prizes as follows: First prize, James C. Green, New York City; second prize, Edwin R. Clark, Lowell, Mass.; third prize, Will S. Aldrich, Boston; fourth prize, D. C. Meyers, Williamsport, Penn. First mention, Pierre A. Liesch, Boston, Mass.; second mention, E. P. Bissell, Philadelphia, Penn.; third mention, F. S. Swales, Rochester, N. Y.; fourth mention, Wm. Louis Goeltz, Long Island City, N. Y. Report of the judges: —

To the Editor of The Brickbuilder:

Dear Sir, — The committee appointed to award the prizes red by the New York Architectural Terra-Cotta Co. for the best gn for an advertising page in The Brickbuilder beg to submit the following report.

The drawings have been ranked in the order in which they are tioned.

The first prize is given to "Ghiberti." He seems, better than any one else, to have combined the qualities of artistic excellence and an element of conspicuousness, which legitimately belongs to a design for advertising purposes. If all the drawings submitted were scattered over the floor, "Ghiberti" would be one of the first which the eye would rest upon as distinguished from its neighbors. Its quality of distinction is undoubtedly in some respect due to the employment of a black background, but it results also from the scale of the design and the simplicity of its conception. The drawing is free and intelligent, although not particularly refined. The space left for illustration in the center is a good feature, which is also employed by the author of the design placed second.

The second design is marked "I. X. L," and is conspicuous, among all the designs submitted, for the remarkable beauty of draughtsmanship displayed in it. Such an admirable handling of the pen is seldom found, and we commend the drawing particularly to all architectural draughtsmen as a brilliant sample of clean, intelligent, and artistic rendering. The design proper is a very agreeable one, although not so strictly a design for a flat page as "Ghiberti's." Its many fine qualities, however, have given it the second rank.

"1144," placed third, is, like the prize winner, an example of the right sort of treatment for decorative design. It is, however, badly balanced in respect to the scale of the various portions, the ornamentation being too delicate for the lettering. The drawing of the figures also is defective, while the eccentricity of the lettering takes away from the dignity of the whole.

Design placed fourth is marked by a "Wreath and Torch." This is, properly speaking, not a design, but a geometrical elevation of a piece of architecture with the lettering incorporated. It has the merit of presenting the name of the advertising firm clearly and unmistakably, and also the merit, such as it is, of suggesting, by the jointing of the design, the employment of decorative terra-cotta.

Design placed fifth is marked by "Dolphins." This is also an admirable piece of pen drawing, although not nearly as good as No. 2. Its conspicuous fault is that it is not an advertisement, the name of the advertising firm occupying a very small portion of the space; nor is the design in itself particularly pleasing.

No. 6, marked by an "Owl," is pretty and sets forth the firm name with distinctness, but the scale of the ornament is rather too small and the top and bottom pieces are conspicuously thinner in effect than the side pieces, so that the frame which is attempted is not completely realized.

No. 7, submitted by "Haste," has the merit of drawing attention, and is better in scale than many submitted; yet, in our opinion, it attempts too much. Figure drawing in these days must be attempted only by a master.

No. 8, marked "A. D. V. T.," is a painstaking and laborious effort, to which the criticism just made in regard to figures applies. This is not a design for the decoration of a page, but for a piece of actual terra-cotta work, and not a very successful design at that. The whole, however, makes an effective frame for the insertion of a picture, and serves to suggest the nature of the wares advertised.

Robert D. Andrews,
C. Howard Walker,
Edmund M. Wheelwright,
Judges.

At the Annual Convention of the American Institute of Architects, held in St. Louis in October, the following list of officers was chosen: George B. Post, of New York, President; Henry Van Brunt, of Kansas City, First Vice-President; Wm. C. Smith, of Nashville, Second Vice-President; Alfred Stone, of Providence, Secretary; S. A. Treat, of Chicago, Treasurer; and D. H. Burnham, of Chicago, J. W. McLaughlin, of Cincinnati, W. S. Eames, of St. Louis, C. F. McKim, of New York, F. M. Day, of Philadelphia, N. S. Patton, of Chicago, R. D. Andrews, of Boston, as Directors for three years. Mr. W. R. Briggs, of Bridgeport, was elected a Director *vice* Van Brunt promoted.

THE PEN-DRAWING OF BRICK ARCHITECTURE.

BY BERTRAM G. GOODHUE.

SINCE my former paper on this subject appeared in these pages, many excellent drawings of brickwork have been printed in the various professional magazines, as well as in *Harper's*, *The Century*, and other lay periodicals, and if you could be induced to thoughtfully study these drawings with an eye to bettering your own work there would be little need of any written words of mine on the subject.

The fact is, I have described, as thoroughly as in me lies, all the different methods that may be employed, with which I am acquainted, except one, and that is the most difficult. An artist of ability who thoroughly understands texture should be and is able to suggest all the many effects of brickwork without so much as showing one brick, either on sunlit space or shadow. I regret my inability at this moment to direct you to any drawing of this description, although the remembrance of many is vivid enough in my mind. Perhaps we architects and draughtsmen, as I said before, are too accustomed to drawing for those clients and committees, whose constant demand is that everything shall be shown and nothing omitted that may be visible on the completed building, to be familiar with the more delicate effects obtained by the artist pure and simple.

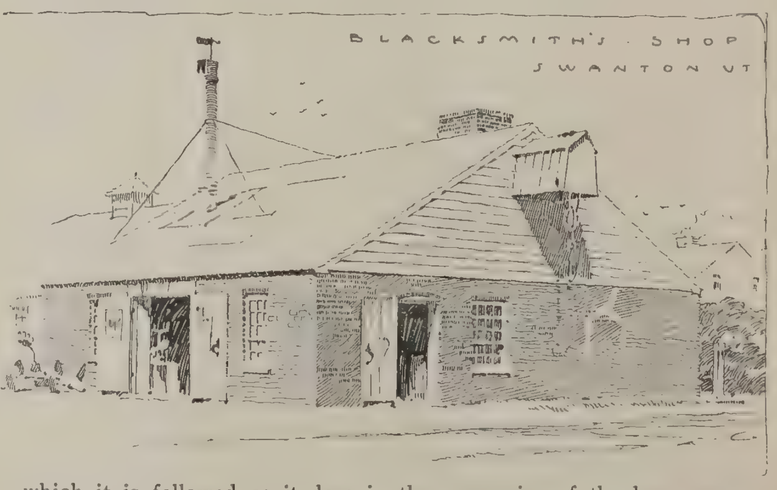
However this may be, the fact remains that drawings have been made in which everything in the way of texture has been suggested, rather than shown, and I believe that by taking thought we may even learn the trick, too. It may be objected that this procedure is contrary to those technical principles which demand that a line drawing should be clearly in line, but even here I believe that with perfectly distinct pen-work one may suggest the appearance of brickwork without attempting the reality.

There are now among us three or four men, in each case the product of the last few years, who are struggling to free themselves from the customary limitations of the architectural draughtsman and reaching out after the flying garments of the artist's ideal. It is pleasant to write that success has crowned their efforts to a considerable extent, and that in the course of a few more years the average excellence of architectural draughtsmanship is sure to be raised many degrees. This struggle is taking place both here and in England, and, for aught I know to the contrary, on the continent as well. Indeed, I remember a wash-drawing of Luca Beltrami's of his design for the front of Milan Cathedral, which is altogether a remarkable piece of work, and one which I should like to examine critically here. However, I must not forget that I am writing upon brickwork and nothing else, though it is true I regret that the scope of these articles is not wider, and that I am not permitted to bring up the subject of trees and clouds, since too many draughtsmen seem to consider their labors ended when, having outlined their building, they have laboriously cast their mechanical shadows and cribbed their single human figure into the foreground to show the scale, a personage which the poor client or committee ignorantly accept as of average size, although none of us need to be told that he is only too often scant of stature to the extent of a foot or two. You perhaps have heard of the most glaring case of this kind in recent years, — fortunately for all concerned, discovered in time by the examining committee. The competition was for one of the most important buildings on this continent, and a favored competitor added quite a little mob of figures to his perspective. Using one of these as a unit, and measuring with stepping dividers the height of the tallest portion of his building — and it wasn't a spire, either — it was found to be 800 ft. high! although described as something under 500. Of course this may have been an accidental happening, but cases of the same nature occur too frequently for them all to be accidents.

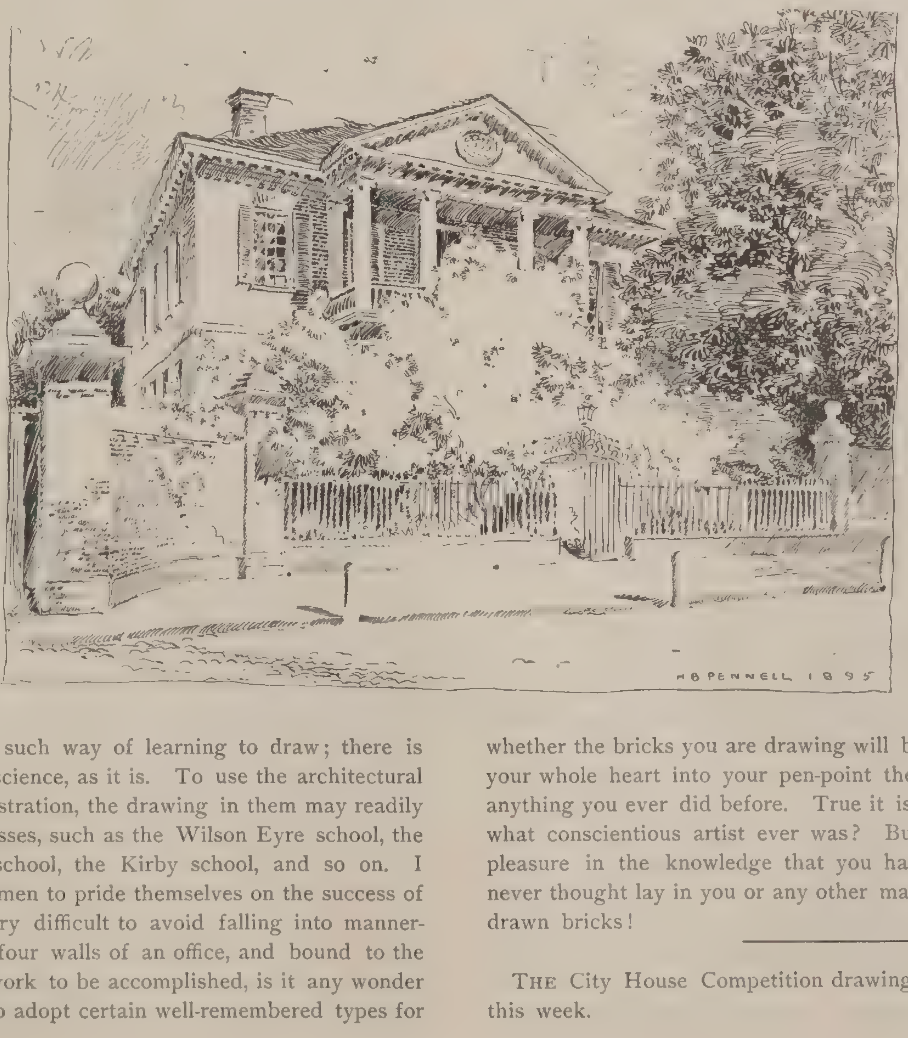
But to return to brickwork and the men who draw it. Mr. Gregg still remains one of the masters of texture in architectural drawing, and it is with a great deal of satisfaction that I print here his hitherto unpublished drawing of the picturesque old blacksmith shop at Swanton, Vt., a building which I fear was included in the recent fire in that town. Here you may see the effect of sunlight shown in a way which is a triumph of skill and directness; at the same time, Mr. Gregg has found unnecessary the usual expedient, — one to which I am addicted myself, — of drawing only shadows and leaving everything else white. Observe that the lines of his brickwork are almost everywhere brought out, and still a few of the bricks are clearly indicated.

There are other men whose drawings of texture are worthy of study, too, though the number is painfully small, and, on running their names over in my mind, I find myself including illustrators, rather than draughtsmen. Of course, there is no reason why I should not do this, but it is a matter for regret that there should not be more among us. Mr. Du Mond, who has since become one of the great artists of this hemisphere, a few years back drew what probably was to him architectural hack-work for the magazines, as scarcely any one else could have drawn it, and Mr. H. D. Nicholls is now following in his footsteps. Among the architects, Mr. H. B. Pennell, Mr. Campbell, and two or three others have succeeded in bringing to their work far more delicacy and *finesse* than is usual in drawings of the kind. Do you remember the picture of the Villa d'Este from the gardens at the foot of the staircase? In this everything is rendered with the same comprehensive understanding, yet there is no monotony anywhere; the lovely building rises white and shimmering in the distance, while on each side in the foreground looms the black mystery of the cypress shade.

Perhaps the secret of good drawing of any kind lies, not so much in the method learned, or even in the painstaking care with which it is followed, as it does in the possession of the keen eye which is constantly on the watch for undreamed-of effects of sunlight and atmosphere, and then, the thought which should be put into the guiding of the hand that strives to portray them. One may have studied with the most capable instructors, bent one's mind to grasp their words and theories to the uttermost, and yet, if one falls into a mechanical habit of work after this, — he is lost. This is the great fault of architectural rendering, and the reason, perhaps, why, no



matter how hard I may try, I can describe only a few clearly defined methods of rendering bricks. On reading over my former article, I can find no other distinct manner to add to those mentioned there that could be considered. To be sure, one may put in each brick mechanically, and with a ruling pen, in the fashion usually followed in scale drawings of brick-detail, and it is possible that a drawing so frankly mechanical would be, even from an artistic point of view, better than some of the miserable abortions of rendering which find their way into the magazines from time to time; certainly it would have the inestimable advantage of being easily understood by those for whom it was made. The great object with draughtsmen in this matter is, I take it, to develop in themselves a good, clear, and at the same time artistic method; one which shall be comprehensible to any client, and yet satisfactory to the maker of it, and I wish it lay in my power to say to you, "Take such and such a brand of ink, such and such a pen, such and such a variety of bristol-board, and then draw bricks in such and such a fashion"; you will readily agree that I cannot do this. What I might do would be to tell you that such and such a draughtsman's work was so good that you might with advantage copy it as closely as you are able. If I did this, and you were to believe in and follow such instructions — which heaven forbid you should do — the result would be most dismal. There might be isolated cases where the natural cleverness of one or two among you would revolt after a period spent on such work, but not quickly enough to take from you a certain amount of the handling learned from another, and then there might result a new manner of drawing bricks, but the chances are that it would be dry and hard, and always so reminiscent of the other man's work as to make the source of inspiration apparent to all. No, I do not recommend any such way of learning to draw; there is copying enough in all conscience, as it is. To use the architectural magazines again as an illustration, the drawing in them may readily enough be divided into classes, such as the Wilson Eyre school, the Gregg school, the Pasco school, the Kirby school, and so on. I have even known draughtsmen to pride themselves on the success of these imitations. It is very difficult to avoid falling into mannerisms; shut up within the four walls of an office, and bound to the daily routine of so much work to be accomplished, is it any wonder that one gradually grows to adopt certain well-remembered types for everything? This is not due to individuality; it is due merely to the prisoned life one leads, far from brooks, and trees, and mountains, and, more than that — for a vivid imagination could transcend such limitations — it is due to the absolute necessity for producing so much work in a given amount of time.



It is a recognized truth that nature is constantly changing in her every aspect; no custom can stale her infinite variety, and so, after years of drudgery with pen, and ink, and paper, some fine day you will arise, and, taking your materials under your arm, hie yourself to the woods and fields, to find there elbow room of mind and body and a thousand other marvelous things never before imagined. With but slight skill you will be able to translate these into line and transfer them to paper; and, believe me, three months of such practise will leave its mark on all the work of your after-years. You don't even need to go to the country or abroad; careful consideration of the buildings on both sides of the street as you are walking to and fro from your office will help you vastly.

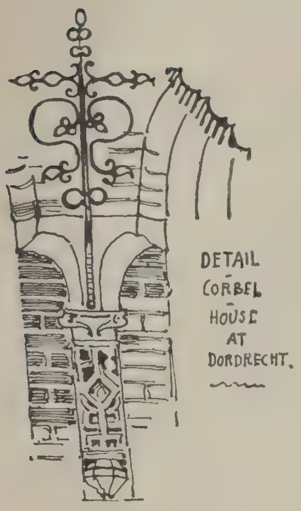
That bricks are tedious things to draw, no one will deny; there are very few who can render them successfully, still these are proof that it can be done, and draughtsmanship is advancing marvellously in quality all the time, — so marvellously that if all illustrative work were not advancing at the same pace we might catch up — the which is Irish, but true. Fifteen years ago current illustration of the average sort was scarcely as good as the best architectural drawing of nowadays, and we may reasonably hope that, apart from figure work, which must always be the stumbling-block to all of us, our work may become as good as the best. There are few enough things to be optimistic about, goodness knows; but this is one of them.

Those of you who were expecting me to teach the gentle art of brick-rendering in one or two easy lessons must be, I fear, grievously disappointed, and yet I can say nothing further than this to aid you in your endeavor. Study the work of the best men, by all means; let your observation of the difficulties met and conquered by them sink into your mind; strive — yes, even strive to please your clients, for that is but wisdom — but strive above all things to please yourselves. To do this thoroughly you will need to bring more thought to your work than one in a hundred does at present; you will need to let your eyes consider many things which at present escape them; and, if so be you are enabled, you would do well to work from nature herself. When you do this forget all about the clients, the light in the office, whether the bricks you are drawing will bond or not, and if you put your whole heart into your pen-point the result will be better than anything you ever did before. True it is, you may not be satisfied; what conscientious artist ever was? But you will be able to take pleasure in the knowledge that you have accomplished what you never thought lay in you or any other man to produce, — artistically drawn bricks!

THE City House Competition drawings are in Rochester, N. Y., this week.

THE BRICK ARCHITECTURE OF HOLLAND.

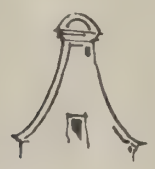
BY R. CLIPSTON STURGIS.



IN the first article I reviewed briefly the remarkable history of the Dutch people and gave some of the general characteristics of their work. In the present article I propose to take up the houses and see how the Dutch used the common material to make them interesting.

I think one is first struck by the unambitious character of the work, and then by the spirit of homelikeness which pervades it all. This is especially true of the smaller towns and villages, but it is also true to some extent of the larger cities. The older streets of Amsterdam depend almost solely for their picturesque effect on the broken skyline formed by the sharp gables, which in themselves are not as pleasant in form as those prevalent elsewhere, being often very narrow and slightly concave (a), the coping sometimes ornamented with rather ungainly scrolls and garlands of fruit (b). In other towns, as in Haarlem, for instance, the gables are largely stepped, with often no attempt at ornament beyond the use of coigns. Such gables as (c) are very simple in detail, and yet present a lively and picturesque effect in perspective, owing largely to the skyline, and to the isolation, and consequent emphasis of the white coigns. The streets also gain much from the accent of the perpendicular lines of the window and door frames, which, painted white and set flush with the outside, are a marked feature in the perspective.

The more modern houses of the Heeren and Keizer's Grachts are plain brick fronts, such as were built in all our Eastern cities fifty or a hundred years ago. Older New York, such parts of it as modern improvements have spared, Washington Square and below, is full of just such houses, and they largely composed the streets in Boston which were swept by the great fire.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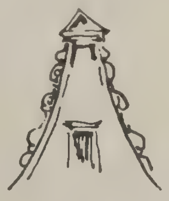
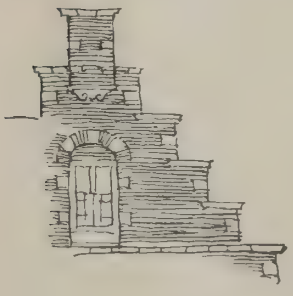

b

Within the simple houses of Amsterdam I dare say we should find as much real treasure, as much refinement, as much evidence of advanced culture as is to be found among the pretentious palaces above 42d Street. It is, however, in the smaller and less modernized towns that we find the most interesting examples of brick houses. Delft, Dordrecht, parts of Haarlem and Utrecht, and, further north, Enkhuisen and Hoorn, all furnish us with innumerable examples of good brickwork. Most of them date from the sixteenth and seventeenth centuries.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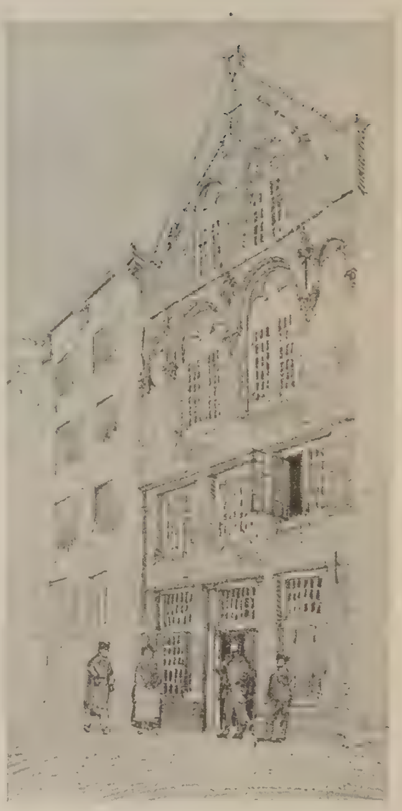
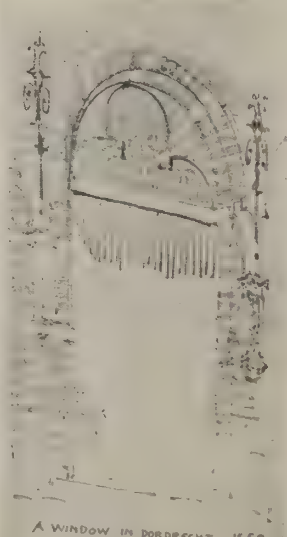
To appreciate what it meant to do good work then, I must just glance again at the condition of Holland. Orange had died in 1584, and, although there had been a comparative lull for awhile before his death, troubles again pressed on Holland when the great leader was gone. One might almost say that all the best architectural work of Holland was done during their years of greatest duress, when they were oppressed on all sides, rent with wars without and schisms within. Church building, of course, came to an end with the general revolt of the country against Roman Catholicism, and this accounts for the large number of unfinished towers and spires, which I shall consider in another article, but secular buildings, both private and public, increased and multiplied, showing in every work the strong spirit of an artistic people.

In all the houses of the towns mentioned above one cannot but be struck with the thorough mastery that the Dutch have obtained over their material, both in production and in working and laying, the brick are so accurate, and so beautiful in texture, so nicely cut and moulded, and so fairly laid. Nothing better can be done in these materials than we find done here.

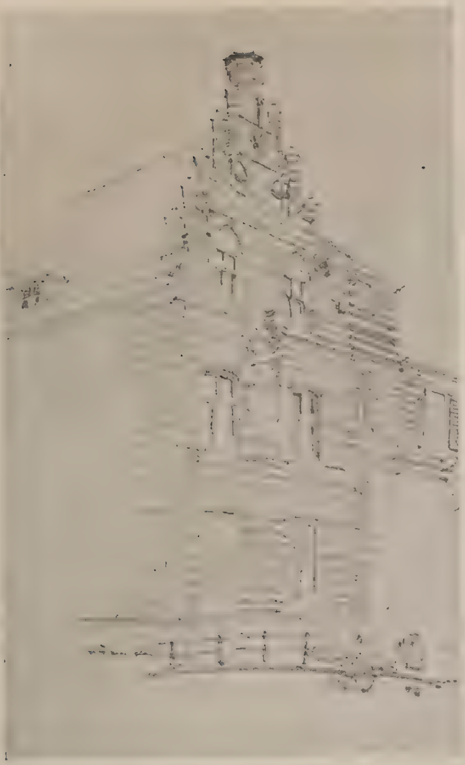

DORDRECHT. FIG. I.

Then one is struck by the fact that they never try to do with brick what it is unsuited for,— they never try to conceal joints and make their walls look smooth and unbroken, like a surface of cement, and they never attempt any ornament which is not a legitimate constructive use of brick; but they make the most of every opportunity which the material affords to a skilled workman.

Take the window of the Dordrecht house (Fig. 2), and, by the way, I must apologize for some of my illustrations, which were made often hurriedly, and generally standing in the street; and they are consequently more or less out of perspective; but in essentials they are fairly accurate, and I thought it better to let them go so than to risk losing some of these essentials in an attempt to re-draw more accurately. To return,— this window has an inner reveal formed by a simple cavetto rubbed in the soft brick, and a projecting reveal to the arch. The corbel, which it would have been difficult to do and do beautifully in brick, is made of stone; so are the leaves which terminate the cusps in the tympanum.


A WINDOW IN DORDRECHT. 1558
FIG. 2.

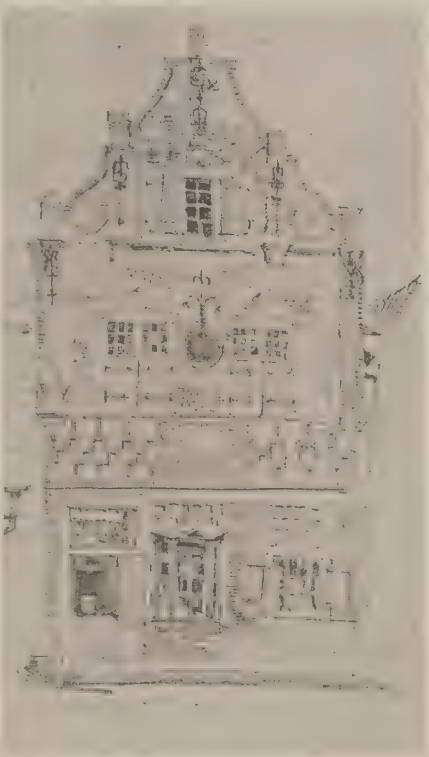
In Flemish work we occasionally see the impossible attempted in brick, but in Holland brick is used quite legitimately and simply, or not at all. The fine lines of shaft and corbel would have been almost a *tour de force* in brick, and the cusps would have lost half of their emphasis if executed in the red brick. As in nearly all cases, so here, the rather wide white joint is an important feature, showing the careful laying of the brick, and giving a clearly defined section of the moulded jamb. The keystone and the two stone voussoirs not only brighten up the façade, but



UTRECHT. FIG. 3.

they accentuate the section of the mouldings more than the joints of the brickwork alone would do. The iron ties shown here are a very frequent feature of all these brick façades, and are often quite beautiful in detail.

As I have noted previously, the houses are invariably simple and unpretentious, yet invariably both homelike and interesting. For myself, I find that it is necessary to accustom the eye, as it were, to the irregular gable outlines and to the sharp contrast and almost spotty effect of the brickwork, divided, striped, or coigned with stone. We are not familiar with this sort of thing at home and have to get used to it, just as we have to get used to striped buildings and the free use of many colored marbles in Italy before we can judge of or appreciate their beauty. For illustration I have drawn from sketches made during a somewhat limited visit and in a comparatively small number of places, supplemented by plates from Van Ysendysk's beautiful work on Holland and a few photographs kindly loaned me by Mr. Cuypers, the well-known architect of Amsterdam.

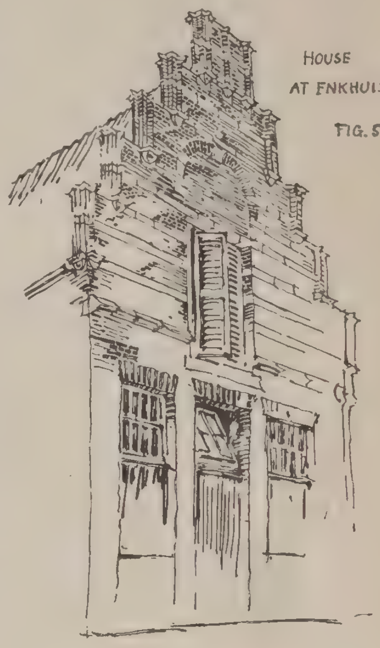


IJERSTEIN. FIG. 4.

Fig. 1 is a house at Dordrecht and is typical of many of the simpler buildings. There is very little attempt at ornamentation — even the stepped gable is omitted — but we have the overhanging stories and the nicely detailed arches over the windows of the third and fourth stories. In this building the general good effect is largely dependent on the nice proportions of the stories, the emphasis given to the chief rooms on the third floor (the second being a mezzanine), and the color of the brickwork.

Fig. 3 is one of the old houses of Utrecht, and a rather unusually good example of the striping of brick and stone, which was probably brought to Holland from Italy. It never seems to me quite at home except in Lombardy, and the few examples in Holland, in England, and here generally look out of place, like a lost animal of strange breed. This house, however, has a really homelike air and a simplicity of façade which is very pleasing. All the effect is concentrated in the striping and the stepped gable with its pinnacles of brick and stone. The canopied niche occupying the space between the second-story windows was gone when I was sketching, to come back again restored. In this case, I trust, not like much English restoration,— the shell without the spirit,— but really restored by a man in touch with the tradition that originally carved it.

Fig. 4 is a shop in Ijerstein, and is an example somewhat unusual of effect gained by offsetting the brick to form a pattern, instead of depending on color alone. Both the pattern under the second-story windows and the coping of gables are made with brick on edge projecting a half inch or so from the ashlar. I think this is a very doubtful expedient for getting effect; it never seems quite constructional, as the projecting upper surface of the brick is exposed to the weather and the joint, also; but this particular instance has stood three hundred years, and that is, perhaps, as much as we could expect. There is the same honesty of purpose here as elsewhere,— the simple shop below, the more lofty second story for storage, and the attic, — simple proportions and straightforward work. The years have done much here to make interesting what, if new, would be a comparatively commonplace piece of work — I mean commonplace for Holland.

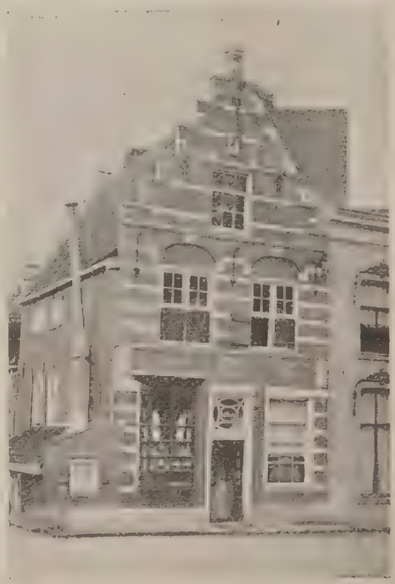


HOUSE AT ENKHUISEN. FIG. 5.

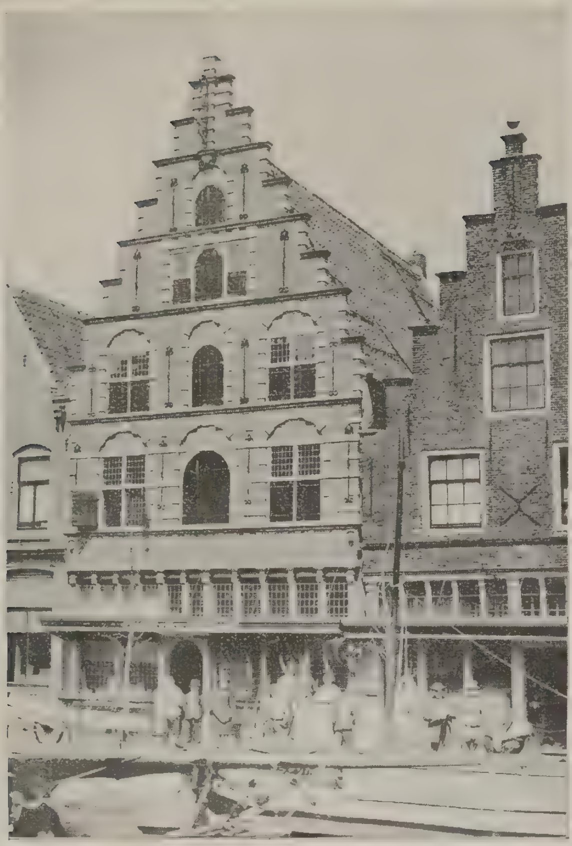
Fig. 5— a gable from a house in Enkhuisen, — is chiefly interesting for the pinnacles of the gable, which are set diagonally, and so well laid that they have withstood the weather for a couple of centuries or more. They seem, perhaps, a little unrestful, but make an extremely picturesque skyline.

Fig. 6 is from Van Ysendyck, a house at Kampden, and shows a simple pattern of diaper formed with stretchers and brick on end, a natural use of stone string-courses and good, thorough bond in brickwork. The anchors are particularly nice in detail, terminating in projecting flowers of various designs. The diaper is placed where it is easily seen, tells for its full value, and is terminated at either end by interesting bits of carving. Even the leanto roof shows a touch of the bricklayers' skill in the nice bonding of the coping.

Fig. 7, from the same source as Fig. 6, is a house at Alkmaar, dated 1609. Here we have very little actual decoration in the brick. There are no moulded brick jambs, no diaper work or pinnacles of brick, but it shows very clearly the accuracy of the



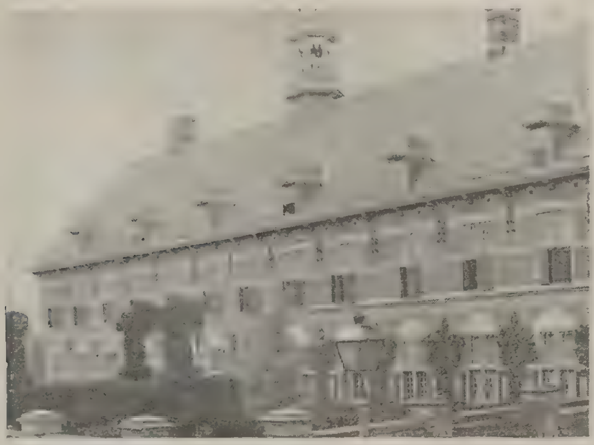
HOUSE AT KAMPEN. FIG. 6.



ALKMAAR. FIG. 7.

bond and the good effect of clear, wide joints. This building, being restored, is especially valuable as showing what the style owes to the real merit of its design and workmanship and what is due to the touch of time; and we can at least feel satisfied that the Dutch know and appreciate the good work they have, for they choose to duplicate rather than to destroy, and are capable of restoring well and in the spirit of the first builders.

Fig. 8 is one of Mr. Cuyper's photographs, and shows the Weerhuis at Buren. It is an excellent example of the use of brick in a large and dignified building, and also gives a delightful glimpse of the formal landscape gardening for which the Dutch are so famous.



THE ORPHANAGE AT BUREN. FIG. 8.

It is, of course, impossible in the limits of a short article and with the space at my command for illustrations to give an adequate idea of how excellent the effect is of the simple brickwork of Holland, so skilfully and so carefully laid; but I shall have accomplished something if I have persuaded any one to try and see what can be done with the simple materials that we have at hand here. To accomplish this, however, it is, first and foremost, necessary that we have brick which will lay up evenly and skilled bricklayers whose idea of bond is not confined to a course of headers to every seven stretchers.

PLATE ILLUSTRATIONS.

PLATE 69.— A window of the Municipia at Monza. This window from the south side of the Municipia or city buildings of Monza is a typical example of Lombard brickwork of the thirteenth century. Voussoirs of sandstone are introduced in the outer arch lines, alternating with broader masses of brick. The columns and sills are also of stone. The jamb and arch molding and the pattern in the tympanum are of brick. The design is instructive as showing what a beautiful effect can be produced by perfectly simple means if the proportions are good.

PLATE 70.— Design awarded first prize in the New York Architectural Terra-Cotta Co. Competition recently held through the columns of THE BRICKBUILDER. The prizes offered amounted to $100 in cash, divided as follows: First prize, $50; second prize, $25; third prize, $15; fourth prize, $10.

PLATE 71.— Balcony on façade of Tremont Temple, Boston. The balcony is the central feature of the façade, and is built of cream-white terra-cotta executed by the Perth Amboy Terra-Cotta Co. It is placed 45 ft. above the street in a flat wall, the face of which is decorated with a quiet diaper pattern of varied coloring, generally of gray tones on a cream-white ground. There is an uninterrupted wall surface of 30 ft. on either side and 20 ft. above this feature. The arched opening is 11 ft. in width.

PLATE 72. — A new store and office building, Winslow & Wetherell, architects, located on the corner of Tremont and Winter Streets, Boston. Built of brick and terra-cotta. Brick furnished by Sayre & Fisher Co.

PLATE 73.— Three designs which won first, second, and third prizes in the William Connors' Competition for an advertisement, held through the columns of THE BRICKBUILDER. The winner of the first prize received $25; second prize, $15; third prize, $10.

PLATE 74. — The First Unitarian Church at Manchester, Mass. A recent example of genuine half-timbered construction adapted to the climate of this country. It consists of an outer frame of seasoned oak and a light interior framework of spruce studding. The outer frame is the true structure, and carries the paneling of the walls and the entire weight of the roof, while the spruce studding gives a nailing for lathing on the inside, and for sheathing of 1¼ in. matched boards covered by building paper on the outer side. The filling of the outer walls below the line of the window sills is brick laid in cement mortar. Above the sill course the panels are plastered with cement mortar, save the borders, which are of brick set flush with the timbers of the oak frame. If the timbers should shrink away from the brick borders the joints could be raked out and pointed afresh without the necessity of renewing the panels.

VIENNA, Austria, is to have an elevated railway, built to run on brick arches. The experience of many years has proved that a brick structure is in every respect the very best for a railway to run upon. There is less vibration and less noise than with a structure of wood or iron. The brick structure is, as a matter of course, a series of arches, and by using a suitable curve for the arch the construction has a graceful and pleasing appearance.

The arches themselves are valuable property, being used for storage, salesrooms, and other purposes. We have seen some fitted up with most expensive tables as billiard saloons, where the players were evidently not incommoded by the passage of trains overhead. It may have been that in this case measures were adopted for deadening the sound, but in another case, where a literary club was established in two or three of these arches, nothing was done to them besides calcimining, and we spent many agreeable hours in the library and reading-room of that club without suffering any annoyance from the trains.—*Brick.*

Fire-proofing Department.

Conducted in the Interest of Building Construction to Prevent Loss by Fire.

EXTENSION OF CITY BUILDING LIMITS.

WHEN, after and as a result of the great Boston fire of 1872, limits were fixed within which frame buildings could no longer be erected, the city of Boston was very different in size and aggregate value from the conditions of the present city, and with its growth has come a need which constantly becomes more pressing for an extension of these so-called building limits.

Where at that time the buildings were separated and comparatively of small size, now large blocks of dwellings, factories, and warehouses extend, without break, from street to street; where formerly buildings were two or three stories in height and contained no great amount of valuable property, they now rise five and six stories and are filled with valuable merchandise or machinery.

This condition of affairs, which then existed only in a limited part of the city, now controls more territory than the whole city contained at that time, and the good of the city demands that the same restriction be applied to the whole of this territory. Within two years we have seen the results which inevitably follow wherever unrestricted construction in the dense part of a city is permitted, and, unless immediate action is taken, the scenes of the Tremont Street fire of May, 1894, will be repeated in other parts of the city. The problem of drawing the new line is by no means an easy one, and can only be properly solved by careful study. This in itself is an additional reason for taking it up at once and giving every point the benefit of mature deliberation.

Such a change is always unpopular, especially with those whose property it affects unfavorably; those, for instance, who must, in consequence of the change, expend much larger sums of money in erecting a building of a given size, or who must abandon some project already in view on account of the restrictions imposed by the building law. Yet it may be well to consider whether at the end of, say, fifty years, any building constructed under the most stringent requirements of the building law will not prove itself a more profitable investment than a less expensive and more inflammable structure. Can there be any doubt that the money expended in the city of Boston for fire protection, if added to the great sums lost there by conflagrations, would have been fully sufficient to put up buildings of the best fire-resisting construction in place of those destroyed? Yet the construction of the light frame building or of buildings with brick *walls* only continues on every side within the city limits where such construction is not rigidly prohibited by law. It would seem wise, therefore, to take the first opportunity for extending as far as possible the protection of the present building law, especially in view of the comparative price of materials of building construction.

The law of 1892 provides that "The city of Boston may from time to time extend the building limits in said city, and may establish other limits in any districts of said city," so that it only remains, therefore, for the city council to fix such new limits as may seem wise to prevent an extension of the compact masses of frame structures which now menace large portions of the city.

It is not the purpose of this article to indicate in any way where the new limits should be drawn, but only to point out some of the probable results of this extension.

Under the present laws governing building construction in the suburban districts, there is little if any encouragement for the investor who desires to put up a building of what is known in the building law as "first-class" construction, *i. e.*, a building in which the amount of combustible material is reduced as low as possible, and, in fact, is confined to upper floors, window frames, doors, and finish work. He is at once confronted with the question of expense as compared with probable income, and, under present conditions, finds that his expensive structure may be closely surrounded by frame buildings of an ordinary class unless he controls a very large amount of territory, and even then must meet this difficulty at all his boundaries. The class of tenants which he is likely to get will be largely determined by the surroundings, and he is likely to find great difficulty in obtaining for the present any adequate return for his money.

Again, the question of fire insurance cost enters not a little into the cost and renting power of his building, and it is not improbable that, in spite of his efforts to have a fire-resisting structure, his surroundings are of such a nature as to justify a rate of insurance which, though lower than the rate on the neighboring property, is still high when compared with a similar building under the conditions which exist within the building limits. Now, were these limits extended, and this argument applies wherever a good, or even reasonably good building law is enforced, the conditions under which new construction must be done are at once greatly modified, and the problem for the investor becomes very different. The new building cannot be entirely or even largely of wood; its height and its area are restricted within somewhat narrow limits unless the building is of "first-class" construction; its stairways, light shafts, elevator ways, in fact, every flue by which fire might be carried from one part of the building to another must be built of fire-resisting material. The construction of the floors must be such, especially in buildings for mercantile or manufacturing use, as to make the use of iron beams almost a necessity, while all "weight-bearing metal" must be covered with material which will resist for a time, at least, the action of a large mass of flame.

On the other hand, if he builds a structure which is of the kind known under the Boston law as "first class," that is, what is usually known as "fire-proof," the height and area of his building can be much greater, and if land values are at all large he will find that the added floor space on a lot of given dimensions will go a long way toward paying for the difference in cost of construction.

His neighbors can no longer build "tinder boxes" under his very eaves, and his insurance rate drops to a figure which seems almost nominal in comparison with the rates upon buildings of the older types. His tenants, too, no longer come of necessity from the cheaper class; they, as well as he, will realize the added security and the improvement in appearance of their surroundings, and this will react on and be felt in the renting power. Freed from the incubus of cheap and ordinary buildings, these parts of the city will improve in character, and values will increase in such a way as to encourage the investor to new construction.

Nothing can be surer than that in the end the best construction is that which is most lasting, and one element of permanency, if not the most important, is power to hold fire in check. With the encouragement that the building law now gives within the "limits" to "first-class" construction, we have already seen more work of this class done within the past two years than in any ten years previously, and a permanent improvement has been effected in this district. The time has come to extend the encouragement to other parts of the city, with good reason to believe that like results will follow within the newly protected territory. Let us hope that before a new season opens we shall see this accomplished, with a firm belief that as a result will come fine structures of brick, terra-cotta, and well-protected iron to replace the flimsy frame buildings which now deface and menace so much of our suburban territory.

THE "COLUMBIAN" SYSTEM.

A SYSTEM of fire-proof floor construction known as the "Columbian" system, patented and controlled by the Columbian Fire-proofing Company, of Pittsburg, Pa., has recently sprung into prominence, and seems to be meeting with great favor.

The system consists of rolled steel bars with double ribs, which are suspended from and attached to beams by means of steel stirrups, which have the profile of the bar cut in them and are hung across the beam — the bars and stirrups being surrounded by and embedded in Portland cement concrete.

Two forms of construction are used: The "paneled," in which the floor alone is constructed, the lower portion of the beam projecting below the ceiling line being encased in concrete slabs, which are molded with iron ties embedded in such a manner that there are no exposed clamps.

BUILDINGS OF LAKESIDE HOSPITAL, CLEVELAND, OHIO.
Showing mixing and hoisting apparatus in use by Columbian Fire-proofing Company.

The second form, termed "flat ceiling construction," is constructed by using a light bar resting on lower flange of the beam, on which ceiling is cast, and floor formed as in "paneled" construction, an air space being left between the floor and ceiling.

The claims made for this floor are: —

First.— That the combination of the special shaped bar and concrete produces a floor of enormous strength and great rigidity.

Second.— That it cannot be broken down suddenly, but in case of severe overloading deflects, so that it is absolutely safe in this respect, and any overload could be detected without any danger of complete failure.

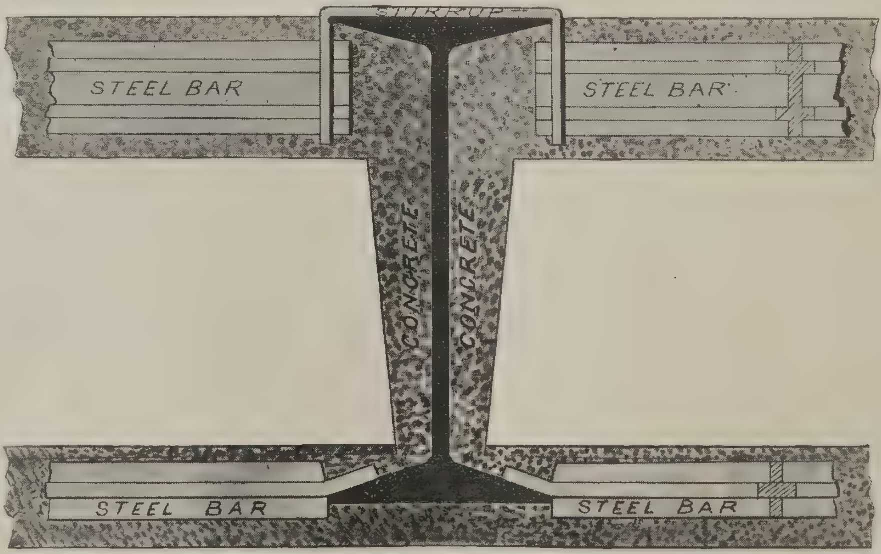
Third. —That it is able to withstand drop or jarring loads to a marvelous extent.

Fourth.— That a heavily loaded floor will withstand the effects of fire and water without any damage.

Fifth. — That it is in most cases the most economical fireproof floor in use.

The first public tests of this construction were made in the L. H. Smith warehouse, Pittsburg, in December, 1894, in the presence of a number of architects, engineers, and public officials.

The distance between center of beams was 8 ft., on which a Columbian floor 3¾ ins. thick was constructed. A superimposed load of 810 lbs. per square foot was placed clear of beams, which remained standing for several days without any deflection resulting. A drop test of 238 lbs. from a height of 8 ft. was also made, the load dropping midway between beams without cracking the floor or injuring it in any way. This drop was repeated several times.



Tests of similar character were subsequently made in various places and in the presence of different people, the loads in all cases being four or five times the required floor load, without deflection. The floors tested were selected at random from work completed. Such tests were made in New York, Pittsburg, Polk, Cleveland, etc.

A very interesting fire test was made by this company in May last under the direction of the Board of Underwriters and Fire Department of Pittsburg. The test was made under the following specifications: —

BOARD OF
FIRE UNDERWRITERS
Of Allegheny County.
Office, 83 Fourth Avenue.

PITTSBURGH, PA.,
March 4, 1895.

COLUMBIAN FIRE-PROOFING COMPANY.

Gentlemen:—The following specifications of a fire test on fireproof floor construction will be required on all non-combustible floor construction before the same will be passed by this board.

Enclose a space of 8 ft. square with a brick wall, having a protected steel beam in the center of same, thus having two half spans of floor arch enclosed; said beam must not rest on enclosure wall, but must be a 12 in., 32 lb. beam with a span of 16 ft. between supports.

Enclosure must be so arranged as to have a flue outlet and a door opening at the other side by which to feed fuel to fire bed.

Place furnace bed 4 ft. below bottom of arch, and maintain a mixed coke and wood fire at as high a degree of temperature as is possible for at least one hour; then beam and arch must be drenched by a plug stream of water, hose to be 2½ ins., with a 1 in. nozzle, under a pressure of 65 lbs.

While fire is in operation the span of the floor must have a load of 750 lbs. to the square foot resting on same.

The test must be witnessed, and in charge of an officer of this board.

Yours very truly,
F. C. BIGGERT,
Ass't Secy.

An examination of the floor after the test was concluded showed that it was not injured in any way whatever, and on the strength of this result a special rate of insurance for warehouse building was granted on this construction by the Allegheny County Board of Underwriters.

This company makes a specialty of large work, and the manne of construction is interesting.

The concrete is measured, mixed, and hoisted automatically. By means of a measuring device, the sand, slag or screenings, and Portland cement are measured and dumped into a hopper which feeds into the mixing machine. The concrete is carried through this and emptied into a boot, through which a bucket machine operates, carrying the concrete to any floor. It simply remains to wheel the concrete and tamp it in place on the floors. The work is thus carried on with great speed, while the other work is in progress.

Great attention has been paid by this company to the proper insulation of columns and girders. Columns are fire-proofed by means of a homogeneous cast of concrete, which not only thoroughly insulates them, but also greatly strengthens the column.

Girders and beams are fire-proofed by means of concrete slabs, so molded as to leave an air space around the girder, to which they are attached by means of clamps cast in the concrete in such a manner that they are entirely protected from the attack of fire.

Concrete formed of Portland cement and the proper aggregates is one of the most fire-resisting materials in use, and with this feature, together with the immense strength and general excellence of all the details, the growing favor with which this construction is received is not to be wondered at.

CONVEYING, MIXING, AND HOISTING APPARATUS,
In use at Pennsylvania State Institute for the Feeble Minded, Polk, Pa.
Columbian Fire-proofing Company.

Amongst the work which this company has executed during the past season may be mentioned: Pennsylvania State Institute for Feeble Minded, Polk, Pa., twenty-three buildings; Lakeside Hospital, Cleveland, Ohio, eleven buildings; Simpson Departmental Store, Toronto, Ont.; Department Public Safety Building, Pittsburgh, Pa.; Cuss Realty Building, New York, N. Y.; four warehouses, three stables, two schools, two telephone buildings, brewery, office buildings, etc. ROD POWELL.

THE Committee on Fire-proofing Tests held a joint meeting with the Advisory Board of said committee on the 14th inst. There were present: Messrs. Reed, Parsons, Rowland, and Heins, of the committee, and the following of the Advisory Board: Professor Henry Morton, president; Professor Huntington; Chas. A. Hexamer, secretary Philadelphia Fire Underwriters' Association; Edward Atkinson, president of the Boston Manufacturers' Mutual Fire Insurance Company; F. H. Kindel, structural engineer of Carnegie Steel Company; F. C. Moore, and H. B. Dwight.

Plans of the proposed testing furnaces were exhibited and a general discussion of the subject of the proposed test followed. The committee reported that sufficient funds had been subscribed to warrant an immediate beginning of construction of the testing plant. The committees then made a visit to the Manhattan Bank Building recently injured by fire.

Mortars and Concrete Department.

Devoted to Advanced Methods of using Cements and Limes in Building Construction.

AMERICAN CEMENT.

BY URIAH CUMMINGS.

CHAPTER VI. *(Continued.)*

THE CHEMISTRY OF CEMENTS.

GEN. Q. A. GILLMORE in his "Treatise on Limes, Hydraulic Cements, and Mortars," ed. 1879, page 304, says: "Magnesia plays an important part in the setting of mortars derived from the argillo-magnesian limestones, such as those which furnish the Rosendale cements. The magnesia, like the lime, appears in the form of the carbonate $(MgO.\ CO_2)$. During calcination the carbonic acid (CO_2) is driven off, leaving protoxide of magnesia $(MgO.)$ which comports itself like lime in the presence of silica and alumina, by forming silicate of magnesia $(SiO_3,\ 3MgO)$ and aluminate of magnesia $(Al_2O_3.\ 3MgO)$. These compounds become hydrated in the presence of water, and are pronounced by both Vicat and Chatoney to furnish gangs which resist the dissolving action of sea water better than the silicate and aluminate of lime. This statement is doubtless correct, for we know that all of those compounds, whether in air or water, absorb carbonic acid and pass to the condition of subcarbonates, and that the carbonate of lime is more soluble in water holding carbonic acid and certain organic acids of the soil in solution than carbonate of magnesia.

"At all events, whatever may be the cause of the superiority, it is pretty well established by experience that the cements derived from the argillo-magnesian limestones furnish a durable cement for constructions in the sea."

G. R. Burnell, C. E., of London, in his work on "Limes, Cements, and Mortars," 1868, page 17, makes the following remarkable statement:—

"In the actual state of our chemical knowledge, it is impossible to say whether there exist any definite proportions either of silica alone, of silica and alumina, or of silica and magnesia, etc., which are capable, when mixed with the same quantity of pure lime, of producing hydraulic limes of similar qualities. Indeed, the whole of this branch of chemistry, notwithstanding the important discoveries made in it of late years, is still very little understood.

"The action of the oxide of iron, for instance, quite escapes the attempts made to include it within any law. The action of the magnesia seems also involved in the same obscurity."

This being the true "state of the art" as late in the history of cements as 1868, it is not difficult to understand and appreciate the conflicting opinions of the leading authorities rendered prior to the date named, as well as those expressed subsequently, and it may truthfully be said that even at the present time the art of cement fabrication is but little understood. In fact, but a slight and scarcely visible abrasion has been made on the surface of the subject, and, considering the limited number of scientists who take any special interest in the subject, it may safely be predicted that any advance in the art is destined to be of slow growth; and that many years will have elapsed before it can truthfully be claimed that the chemistry of cements is at last freed from the fetters of tradition and rests securely on a solid and permanent foundation.

And when it is considered how vastly important the subject is, in view of the fact that over 30,000,000 barrels of cement enter yearly into the works of construction in Europe and America, it is to be regretted that our universities and institutes of technology, do not embrace in their curriculums a systematic study of the chemistry of cements.

So largely does this material enter into the construction of all engineering and architectural works and so rapidly does the field for its use widen that it is becoming a necessity that this subject should receive the attention its importance merits.

As already stated, the discussion concerning the effects of the presence of magnesia in a cement has extended over a long period of years, and, unfortunately, many conclusions have been drawn which are purely hypothetical, and, lacking in practical proof, are not only useless, but, by being misleading, become harmful. An error of this character is afforded in the passage quoted from Gillmore.

Silicates are not decomposed in the manner stated. The only portion of a cement that could be thus acted upon by carbonic acid is the lime and magnesia that may be in excess of true combining proportions with the silica present.

Practical experience has demonstrated that any cement which contains an excess of either lime or magnesia, if not thoroughly hydrated prior to its application, is attended with the danger of expansion. And any cement deficient in these bases is subject to shrinkage. An excess of lime in a cement, whether natural or artificial, without thorough hydration, as already stated, will surely expand to a greater or less extent. And, as the process of hydration as usually practised consists in the mere spreading of the manufactured cement on a floor and by repeated turnings with shovels, exposing the body of the cement to the atmosphere, the caustic lime takes up the moisture in the air, and produces a hydrate of lime which is thereby rendered non-expansive. And its influence on the resultant mortar is the same as when a given percentage of thoroughly slaked quicklime is added to a harsh or quick setting cement, rendering it less active and imparting a pasty consistency to the mortar. An excess of lime in a cement, whether inherent in the cement or added subsequently, if the hydration has been conducted thoroughly and conscientiously, cannot be considered as harmful; on the contrary, it may be, on the whole, beneficial. The only danger attending its use arises from the extreme liability of an imperfect hydration.

The often expressed opinion that any excess of lime or magnesia will ultimately dissolve out of the masonry, leaving the mortar porous, and thereby lead to disintegration, is not borne out by the facts. Teil hydraulic lime, containing thirty-four to forty per cent. of free lime, has been used in enormous quantities for centuries, and certainly in sea water since 1832, and the free lime which it contains shows no signs of dissolving out, whether used in air or water.

In the manufacture of artificial cements, which invariably contain an excess of lime, the question of thorough hydration presents in the case of large and extensive works quite a serious problem, one which enters quite seriously into the cost of manufacture.

The large floor space necessary for the purpose and the time required for thorough hydration, the large stock to be carried and the labor involved in turning, enter into the cost of production, and, as in these days of close and severe competition the strictest economy in manufacture becomes imperative, it is evident that the process of hydration is oftentimes hurried and imperfectly done.

The author has never, in a long series of trials, been able to find an artificial cement of foreign or domestic production which, when made into grout and poured into bottles, would not sooner or later fracture every bottle.

The only significance to be attached to these trials consists in the fact that none of the brands tried contained magnesia in excess of the empiric limit of three per cent.

The expansion, therefore, could not be charged to that source, and the only conclusion to be drawn was that the process of hydration had been improperly conducted, and caustic lime had been permitted to remain in the cement when packed for the market.

Neither lime nor magnesia will expand in a cement if combined with silicic acid or when in a free and uncombined condition, if thoroughly hydrated.

There are no known cements which would be damaged in quality should they contain magnesia up to the combining limit.

We have shown that magnesia combines with silica in certain fixed proportions, and that when lime enters into the composition the proportions as between silica and magnesia are changed, but in either case the proportions are fixed and constant. A true silicate of magnesia will attain a hardness equal, if not superior, to that of silicate of lime.

The former contains a larger percentage of silica, as will be seen from the following table.

Silicate of Magnesia.		Silicate of Lime.	
Silica,	42.92	Silica,	34.91
Magnesia,	57.08	Lime,	65.09
Totals	100.00		100.00

If there is any advantage in the inherent hardness of the constituent parts considered separately, the advantage would seem to be in favor of the silicate of magnesia, as silica is harder than either of the bases named, and, while it requires but 760 parts of water to dissolve one part of lime, magnesia is practically insoluble in water.

An illustration is afforded in the large number of shell-marl beds found in many portions of this country (nearly all of which are formed by animal secretion in the waters of former lakes or ponds). Although the surrounding or adjacent rocks are in most instances magnesian limestones, from which by infiltration the ponds became supplied with calcium carbonate in solution, and from which the shells were secreted, it is very rarely that the shells are found to contain even three per cent. of magnesium carbonate — being practically pure calcium carbonate.

Several years ago, the author, in searching for a reason for this general belief in the dangerous qualities of magnesia in a cement when exceeding the time-honored limit of three per cent., instituted a series of experiments.

Magnesian limestones were secured which varied in their proportions of carbonate of magnesia from five to fifteen per cent. These were marked and treated separately, by grinding the samples to impalpable powder, to which was added clay in an equally fine condition, in such proportions as are prescribed as the correct formulæ for Portland cements, and, after a thorough admixture of these ingredients, the samples were moistened and formed into balls and cakes, which were then calcined with coke to the point of incipient vitrifaction, after which the samples were finely pulverized, the powder thoroughly hydrated, formed into patties, balls, and briquettes, and given the usual time in air and water.

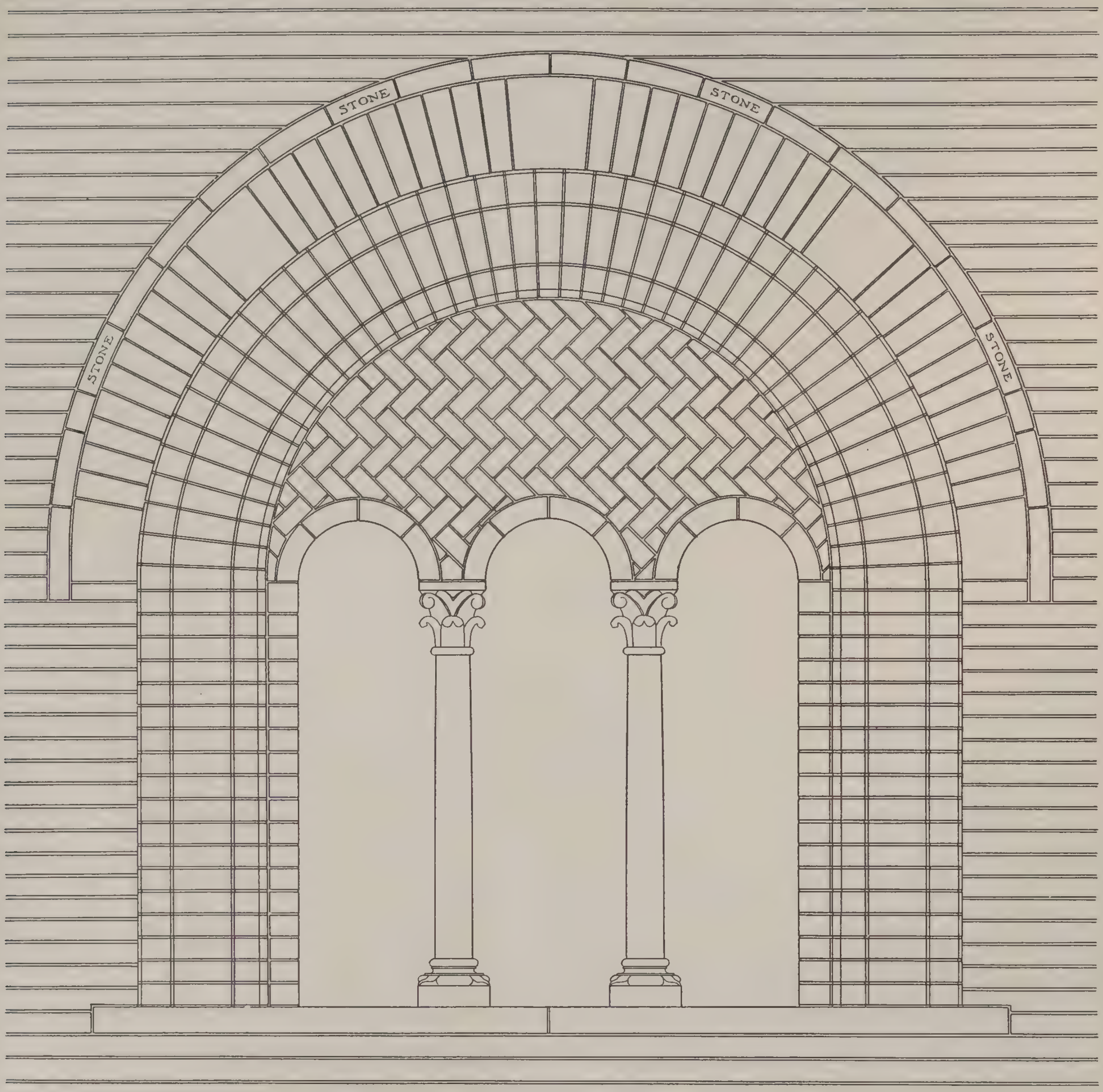
The tests extended from one day to one year. The weight and tests were fully up to the standard for the best artificial cements. Some of the samples are now nine years old; they have been kept in both fresh and salt water, and they show no signs of expansion or checking, and they are exceedingly hard.

Following in this line to determine if it were possible that a good cement could be produced, should the lime be replaced entirely by magnesia, many experiments were conducted with various substances known as silicates of magnesia, with varying success, until a trial of serpentine ($Mg_3\ Si_2\ O_7 + 2H_2\ O$) was reached.

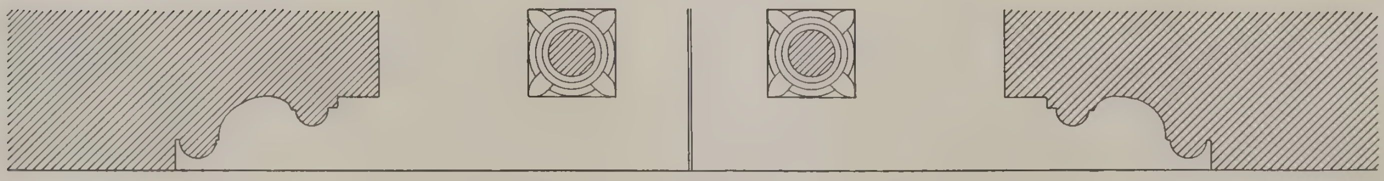
In the experiments with this material much difficulty was experienced, owing to the varying qualities of this rock. It was found that verd-antique, a mixture of serpentine and calcium carbonate, and many samples mottled or otherwise not uniform in color or texture gave results that were not entirely satisfactory. But the dark green varieties which were uniform in color and fine in texture gave results that were most surprising.

Samples of this class from near Philadelphia, Penn., near New Haven, Conn., and Marquette, Mich., yielded an hydraulic cement that equaled in hardness and toughness the best natural or artificial cements.

(*To be continued.*)



ELEVATION

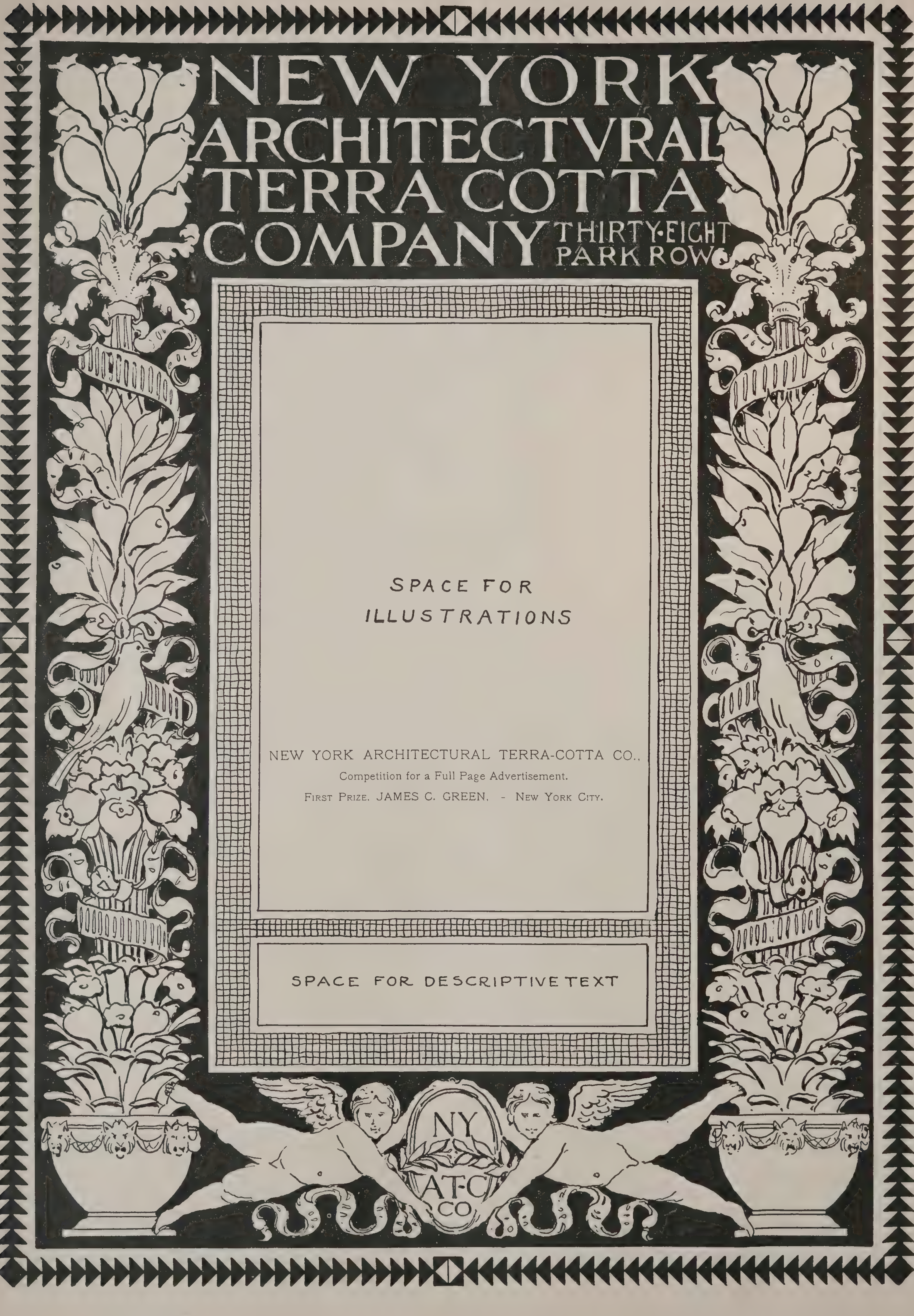


PLAN

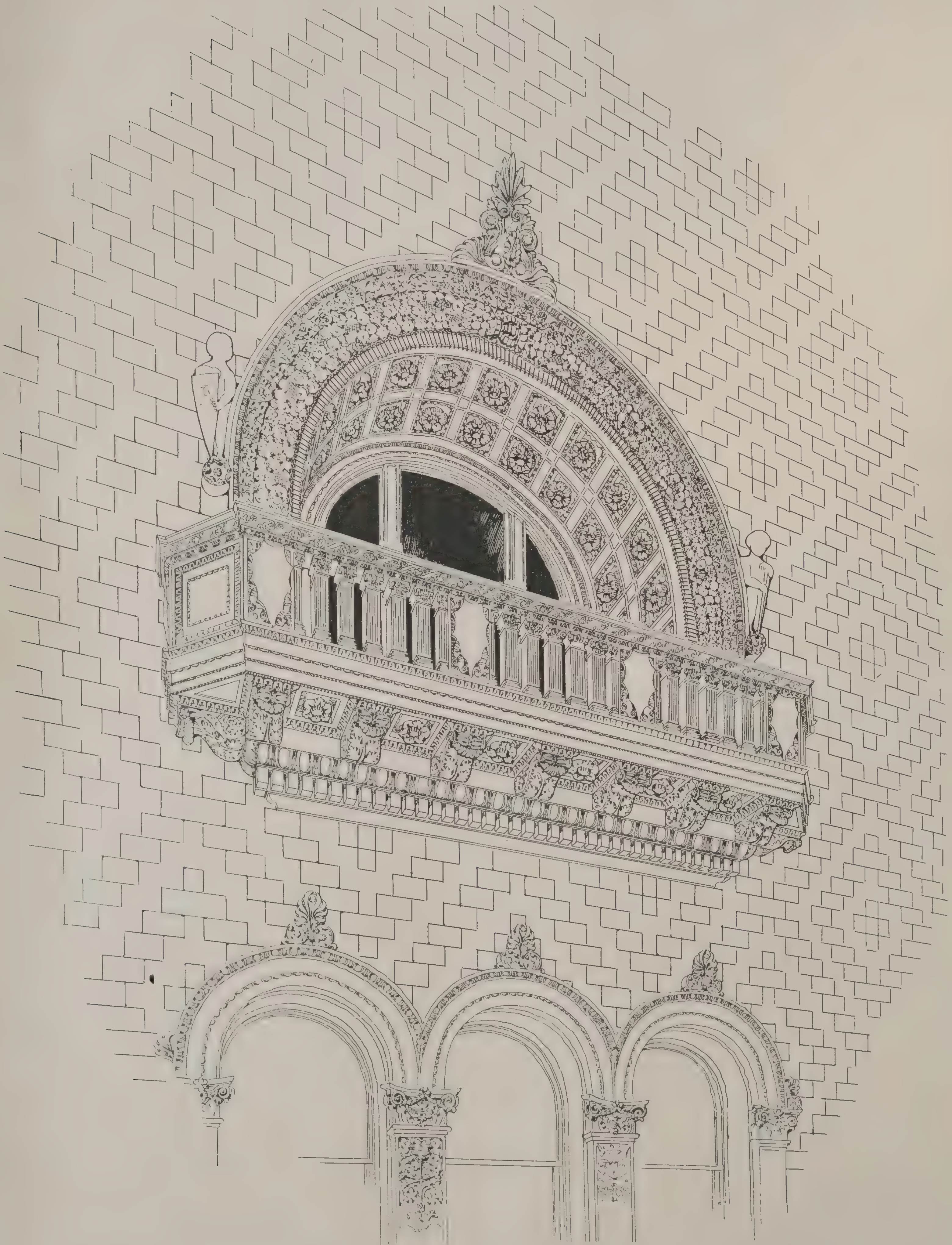
SCALE

NOTE. Voussoirs Brick and Sandstone.
Columns and Sill Stone.
All other Work not marked differently, of Brick.

MEASURED DRAWING OF WINDOW IN SOUTH SIDE OF MUNICIPIA MONZA, THIRTEENTH CENTURY.



NEW YORK ARCHITECTURAL TERRA-COTTA CO.,
Competition for a Full Page Advertisement.
First Prize. JAMES C. GREEN, - New York City.

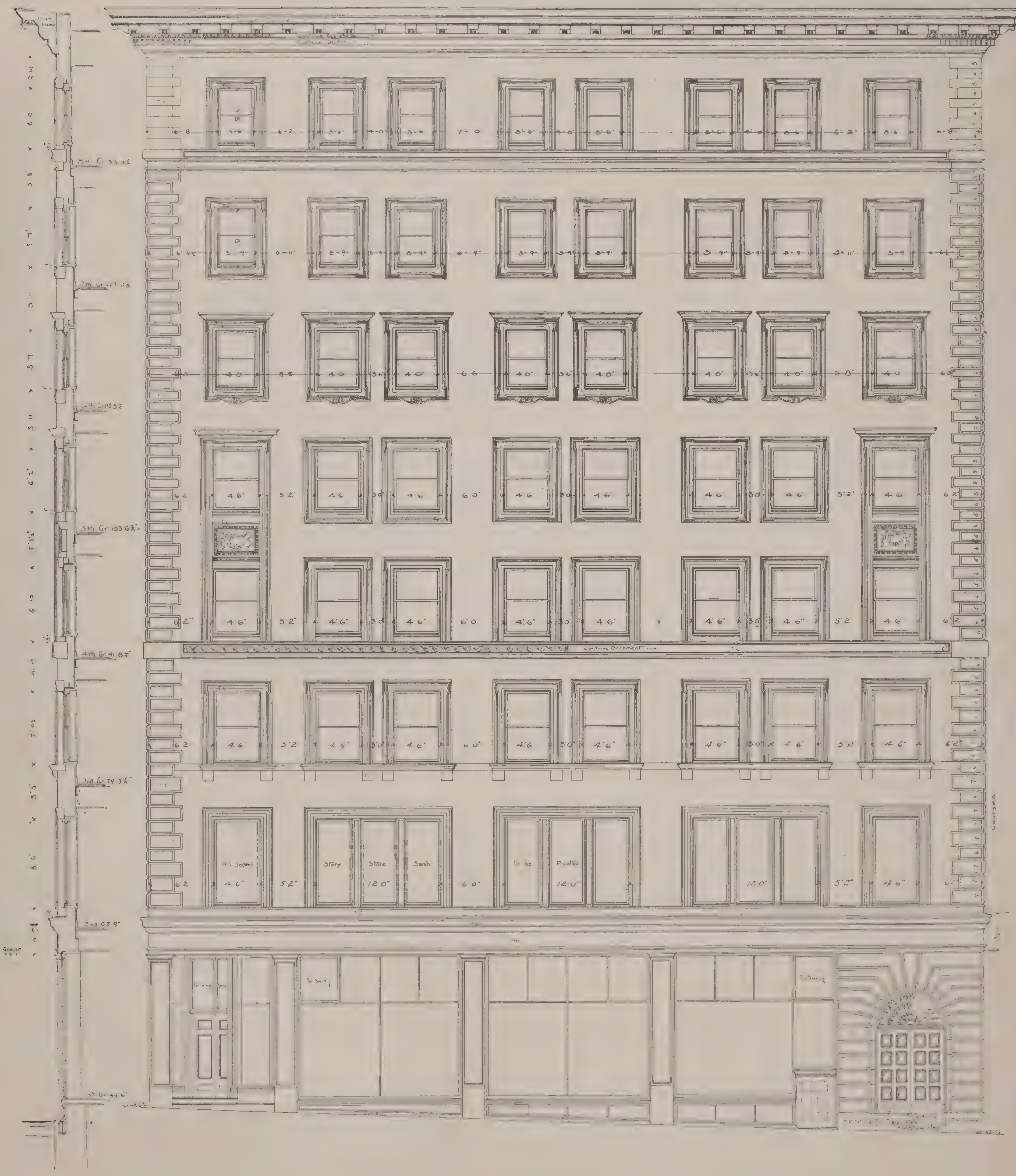


CENTRAL BALCONY, TREMONT TEMPLE, BOSTON.

BLACKALL & NEWTON, Architects.

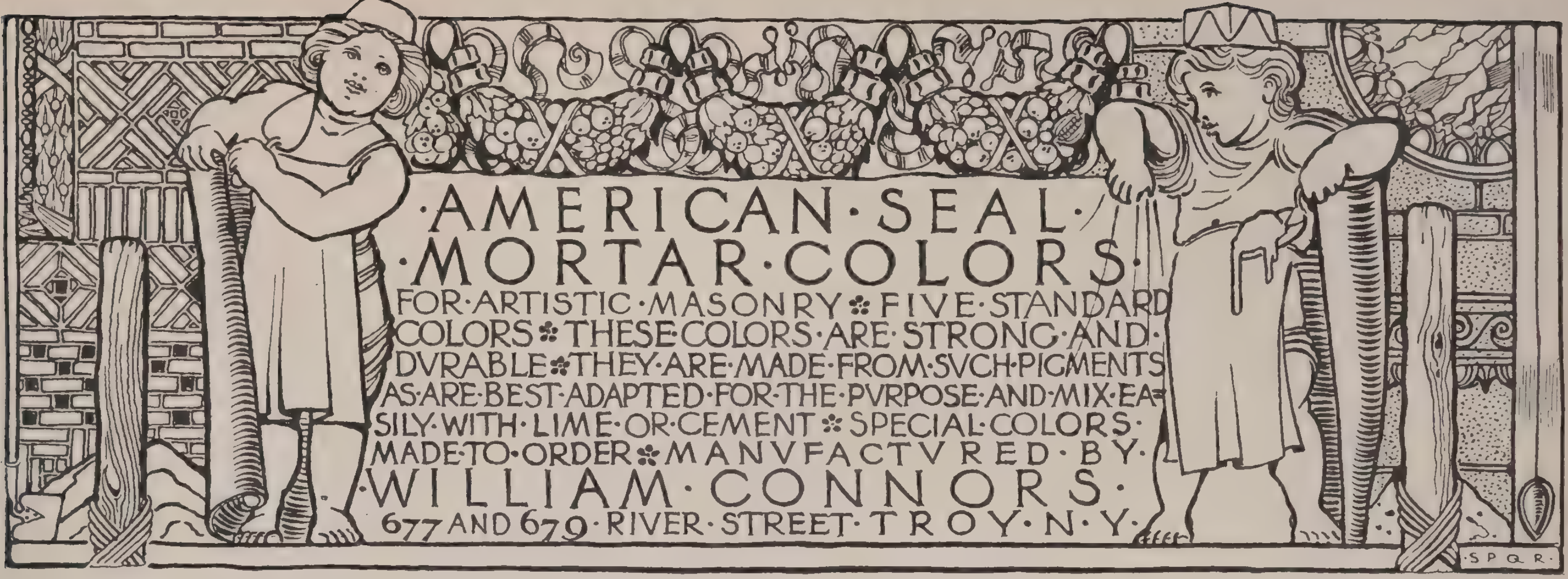
THE BRICKBUILDER.

VOL. 4. NO. 11. PLATE 72.



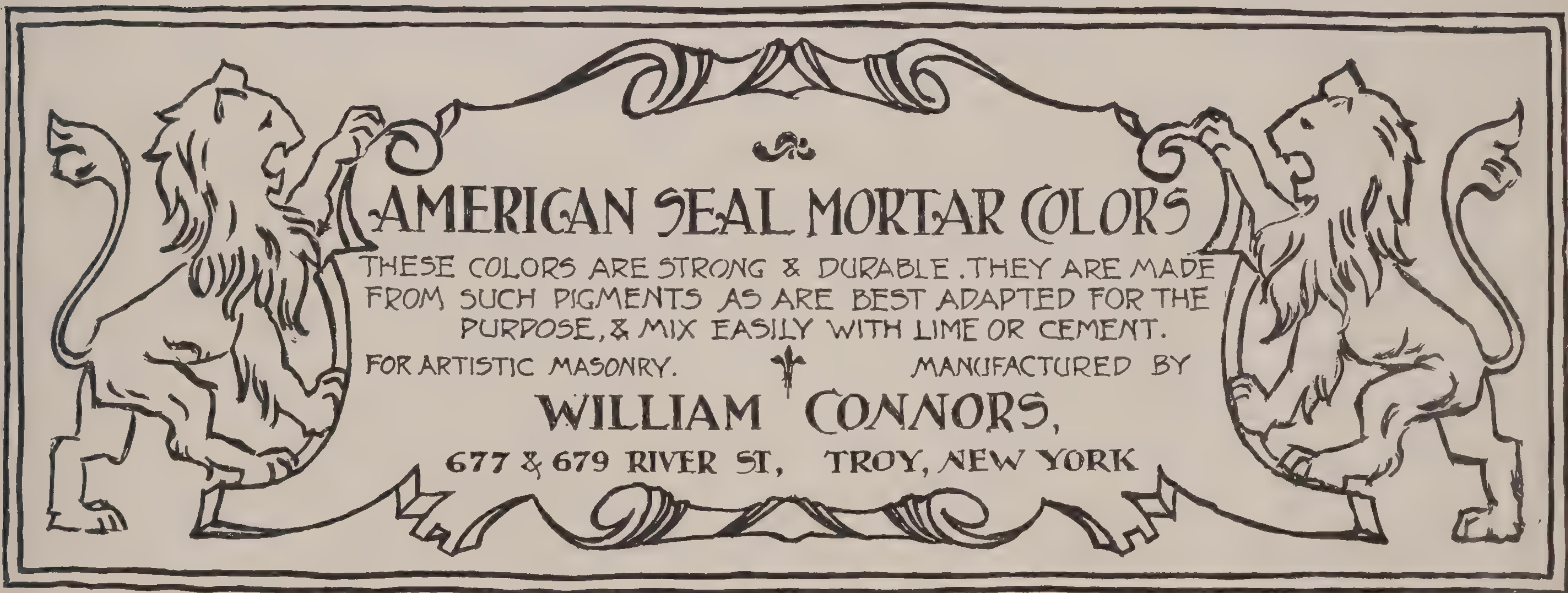
ELEVATION OF OFFICE AND STORE BUILDING, CORNER WINTER AND TREMONT STREETS, BOSTON.

WINSLOW & WETHERELL, Architects.



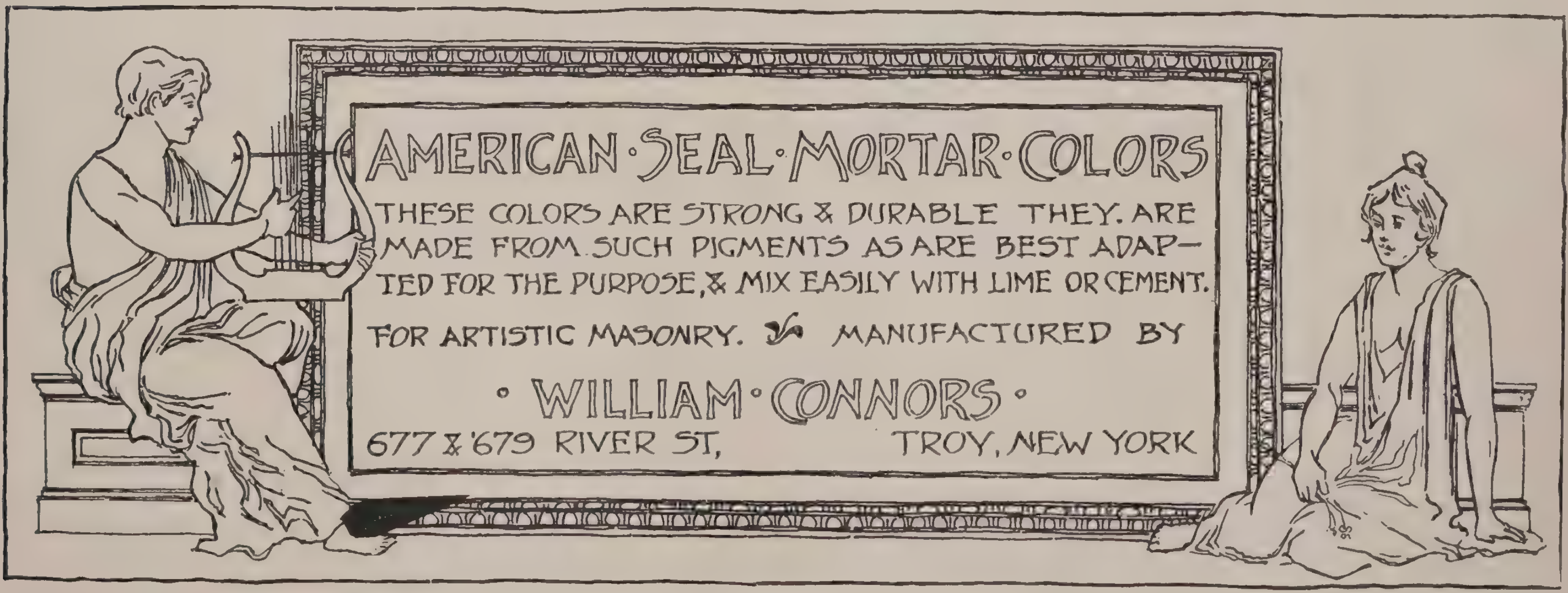
·AMERICAN·SEAL·
·MORTAR·COLORS·
FOR·ARTISTIC·MASONRY ✿ FIVE·STANDARD COLORS ✿ THESE·COLORS·ARE·STRONG·AND· DVRABLE ✿ THEY·ARE·MADE·FROM·SVCH·PIGMENTS AS·ARE·BEST·ADAPTED·FOR·THE·PVRPOSE·AND·MIX·EASILY·WITH·LIME·OR·CEMENT ✿ SPECIAL·COLORS· MADE·TO·ORDER ✿ MANVFACTVRED·BY·
·WILLIAM·CONNORS·
677 AND 679·RIVER·STREET·TROY·N·Y·

First Prize, PIERRE A. LEISCH, Boston.



AMERICAN SEAL MORTAR COLORS
THESE COLORS ARE STRONG & DURABLE. THEY ARE MADE FROM SUCH PIGMENTS AS ARE BEST ADAPTED FOR THE PURPOSE, & MIX EASILY WITH LIME OR CEMENT.
FOR ARTISTIC MASONRY. MANUFACTURED BY
WILLIAM CONNORS,
677 & 679 RIVER ST, TROY, NEW YORK

Second Prize, H. F. LEHR, Allentown, Pa.



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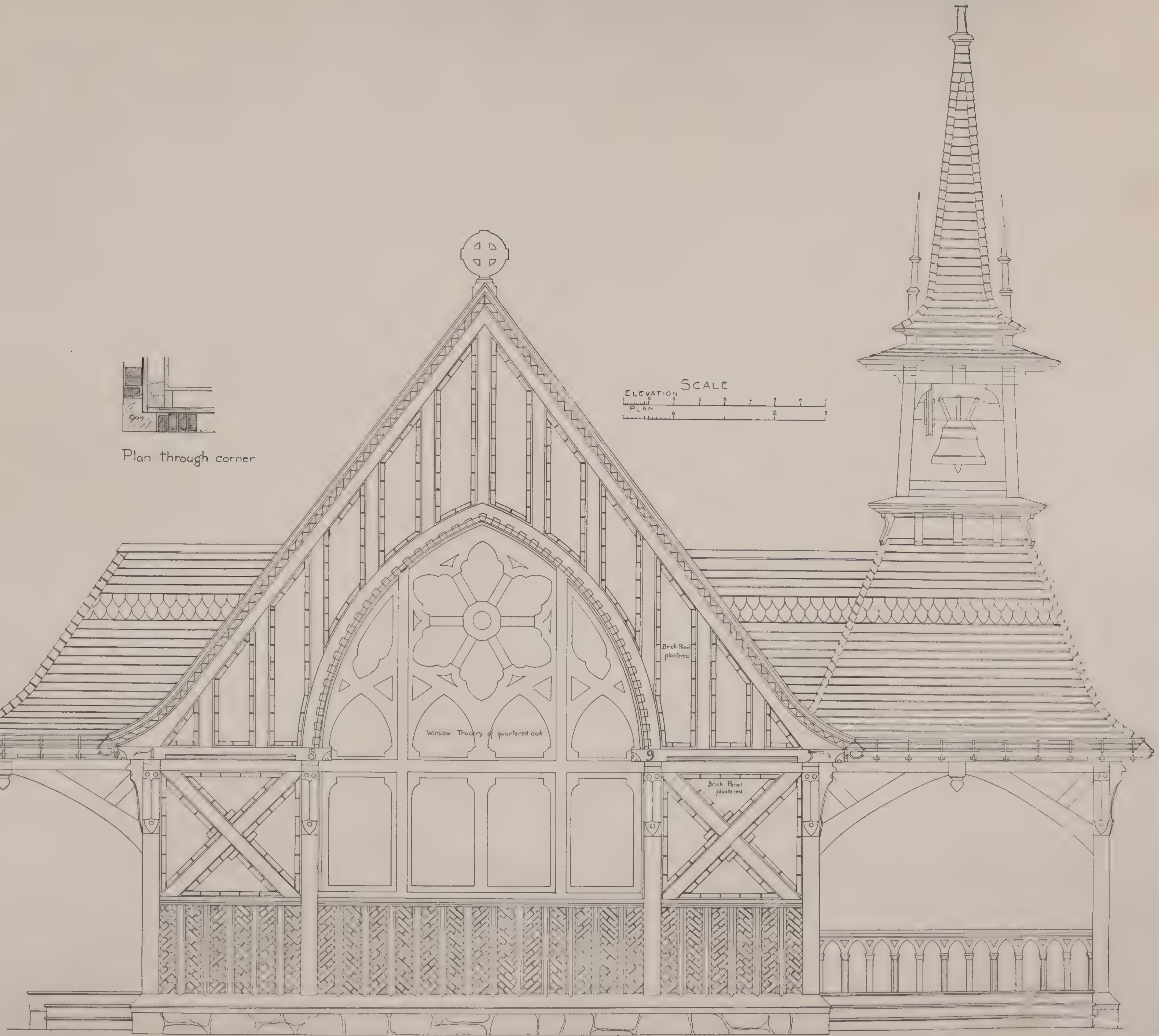
FOR ARTISTIC MASONRY. MANUFACTURED BY
· WILLIAM · CONNORS ·
677 & 679 RIVER ST, TROY, NEW YORK

Third Prize, CHARLES WIERBACH, Allentown, Pa.

WILLIAM CONNORS' COMPETITION FOR AN ADVERTISEMENT DESIGN.



UNITARIAN CHURCH, MANCHESTER, MASS. BRICK AND HALF-TIMBERED CONSTRUCTION.

COOLIDGE & WRIGHT, ARCHITECTS.

EDITOR OF THE BRICKBUILDER:

Dear Sir, — I believe your columns are always open to friendly discussion, and I hope you will afford me a little space to discuss the report of the Master Builders' Exchange of Philadelphia on standard specifications for cement published in your October number.

The report mentions that its clauses are based largely on those of the American Society of Civil Engineers formulated ten years ago. Since that time rapid advance has been made in cement making, and the American Society of Civil Engineers feel that their specifications are a little out of date, and are, I believe, considering the idea of remodeling them. The gentlemen forming the committee reporting on the matter should have investigated the matter more fully or taken expert advice before committing themselves to such a lax set of specifications as they have placed on record for public approval and their own use. To take up the matter, clause by clause: —

1. *Specific gravity.* During the last three years I have tested very carefully about forty brands of Danish, German, Belgian, English, and Canadian Portland cements, and not one of them has gone as low as 3.00 in specific gravity; therefore, I consider a clause demanding a value of 3.00 for specific gravity is of *no value* whatever to prevent under-burnt products. Natural cements, also, usually range from 2.90 to 3.05; therefore, there is little use in specifying a minimum of 2.50 for natural cements. A specific gravity of about 3.09 for Portlands and 2.90 for naturals would really obtain what was intended, — namely, well-burnt products.

2. *Fineness.* Why should there be two classes of tests? Surely, any two persons can sift cement the same, whether in a laboratory or in a contractor's shanty. What should be specified is that a certain amount of cement should be used in sifting, and that the sifting should be continued such a number of minutes; then uniformity will be obtained. For myself, if I use 10 ozs. of cement, and sift two and one half minutes on a No. 120 sieve, then sift the residue one minute on a No. 100 sieve, then the residue three fourths of a minute on a No. 80 sieve, then the residue one half minute on a No. 50 sieve, I find the residues are about uniform in size and color. I obtain close uniformity. If only a No. 100 and No. 50 sieve are used, the same method could be employed.

Regarding the actual amount of residue demanded, that is entirely a matter of dollars. Fine grinding must be paid for, but the clause, as set forth in the specifications being dealt with, is so lax as to call forth a protest.

Any natural cement having more than 15 per cent. residue on a No. 100 sieve should be certainly rejected, because they are so lightly burnt as to make it very easy to grind them finely. It is quite easy to obtain Portlands and naturals with only 10 per cent. residue on a No. 100 sieve, and this is the requirement of the standards of Canadian Society of Civil Engineers, formulated in 1894.

3. *Checking or cracking.* No checking when exposed in air or water! How long are we supposed to wait? The report does not say, but from a great number of experiments I have made I would say that cements with a slight amount of free lime in them will stay solid in *cold* water for several months, but finally crack. The only way to develop "blowing" in a short time is to subject the cement pats to hot air or hot water.

4. *Strength.* With ordinary care, neat cement briquettes made in the ordinary way, by using sufficient water to make a plastic mortar, then putting the mortar into the molds with a trowel, and shaking the molds well to drive out air bubbles, will give fairly uniform results; but in making *sand tests* the method of putting the mortar into the mold is the whole matter; a one week test, three to one, can be made to vary all the way from 25 to 150 or even 225 lbs., depending entirely on the manner of placing the mortar in the molds. Therefore, a clause not stating how this is done is of no value whatever, even if the clause stated that the mortar should be *rammed* into the molds. There are as many ways of *ramming* as there are operators, and the results might vary by at least 100 per cent.

Personally, I consider sand tests are of little value, because if the clauses of specific gravity, fineness, blowing (or checking), and neat tensile strength have been satisfied, then one can predict the comparative sand test value; but if sand tests are wanted, then I believe firmly that there is only one way to make them strictly comparable, and that is to put the mortar into the molds in a soft, plastic condition, such as is used by masons, and let it be forced into the mold under a uniform dead pressure. This method I have used for over a year, and I feel I can determine accurately the desired knowledge of the actual cementing strength of sand mixtures as used in practise.

Should any of the readers of your paper desire fuller details and results of this method, it would afford me pleasure to publish them in your paper.

Yours respectfully,

CECIL B. SMITH.

McGill College, Montreal.

CEMENT FOR ROOFING.

WASHINGTON, D. C., Nov. 7, 1895.

IN a report to the Department of State, under date of Oct. 19, 1895, J. C. Monaghan, United States Consul at Chemmitz, Germany, gives some particulars cf a new roofing material, recently invented by a man named Kohlers, living in Limbach, Saxony.

This material consists of cement and gravel, is as durable as slate and much cheaper, looks as well, if not better, and can be made much easier and put on quicker than slate. In a country like the United States, says the consul, where wooden shingles are almost universally used, and by reason of which fact the danger from fire is greatly increased, this new roof will soon win its way into favor.

This roofing material is composed of one part cement and three parts sand. These are mixed into a mortar-like consistency through the addition of clean water, after which the mass is pressed into a mold. The work of mixing and pressing is so simple that it can easily be done by boys.

Its most practical value as a substitute for wooden shingles is that the cement roof is proof against fire. It fills, too, every requirement of a good roof, being durable, proof against all kinds of weather, and is light. It may be made as light or as heavy almost as any one would wish and it can be given all the colors of natural slate, besides fifty more shades possible.

A square meter of this material will weigh thirty-eight kilograms, or, say, one square yard represents a weight of seventy-six pounds, though, as mentioned above, its weight can be varied at will.

Two houses in Germany have turned out from ten to twenty million such "plates" as above described in the last few years, simply because they were found to be superior to all other styles of roofing, but this roof prepared by Kohlers is the best yet produced. This distinction is owing to the fact that a ridging or grooving is run on the inside of the plate, and permits of one so lying on and into the grooves of another as to preclude the possibility of wind or water making their way inside.

Nothing whatever is welded for the Kohlers roof except these plates, as nails, paints, and plaster play no part in its manufacture or installation. Plates may be made of pressed glass in exactly the same form, and fitted to roofs, thus avoiding the cost of building in windows.

The cost of production is nominal. Both material and machines necessary to make this roofing are very cheap. A machine with three hundred full size and one hundred half size molds costs less than five hundred dollars. Of course the cost per square yard of the tiling will then depend upon the prices paid for sand and cement.

Machines and material may be transported to the place of building, and the plates can be made on the ground, thus avoiding breakage, although well-made plates are as hard as bricks and not more liable to loss from breakage.

It has been patented in almost, if not in every, civilized country. In conclusion, Consul Monaghan says: "I write about this particular cement roof, because I believe it is bound to revolutionize roofing all over the world, and because it came forcibly under my own personal observation right here in Chemmitz."

HYDRAULIC MORTAR.

A GERMAN contemporary has an interesting article in a recent issue on the influence of soft water and of sea water upon the hardening of hydraulic mortar. As so many of our readers are not only clay-workers, but users of clay-workers' productions, we think a note on this subject may be of service.

Experiments were carried out by Herr N. M. Koning and Herr L. Bienfait with various mixtures of Portland cement and sand, to which in some cases a proportion of hydraulic lime was added. These mixtures were then molded into bricks with sea water or soft water, and immersed for periods ranging from one to six months in sea water and soft water respectively. At intervals the bricks were subjected to the usual mechanical tests.

The article in which their experiments are described discusses in detail every step taken during the investigation. It will be sufficient for our purpose, however, to notice the results arrived at.

In the case of the mortar which was made by mixing with soft water, and which was subsequently submerged in soft water, it was found that the rate and degree of hardening, especially during the early part of the time, was increased when hydraulic lime entered into the composition. This effect was weakened by increasing the amount of sand in the mixture.

The mortar which was made with and afterwards immersed in sea water did not harden so well nor so quickly if hydraulic lime entered in any proportion into their composition. All these mortars gave inferior results to those in which soft water was used.—*British Clay-Worker.*

THE EFFECT OF FREEZING ON CEMENT MORTARS.

IN an article recently published in *Engineering News* Messrs. P. L. Barker and H. A. Symonds give the results of a large number of experiments they have carried out on the effect of freezing on cement mortars. Most of the specimens were tested transversely, but control experiments in tension were also made. In order to reproduce the conditions of actual work as closely as possible, the various specimens were caused to set under a pressure corresponding to the average weight of a course of masonry 18 ins. deep. These specimens measured 5 ins. in length by 1 in. square in cross-section. They were tested on a 4 in. span with a central load, and after breaking, the long fragment was again broken on a 2½ in. span. Six brands of cement were used, and were mixed with screened sand in various ratios, and then allowed to set at low temperatures. Both salt and fresh water were used in gauging the specimens. The conclusion arrived at, based on over six thousand results, is that Portland cement mortar suffers no surface disintegration under any condition of freezing, but that in most cases its strength is reduced, in some cases by as much as forty per cent. Rosendale cement is disintegrated when exposed to frost when setting, and its cohesion may be entirely destroyed by immersion in water which becomes frozen round it. Salt water prevents this disintegration to a large extent, but seems to have an injurious effect on the strength. The cement below the disintegrated surface is stated to be increased in strength when the Rosendale cement is used. A mixture of a natural-rock cement and of Portland cement gave very satisfactory results, as its surface did not disintegrate, and its strength was increased by the freezing. Portland cement is injured less proportionately as the percentage of cement in the specimens is reduced. Lime mortar is ruined by alternate thawing and freezing, but fairly good results can be obtained in the case of brick masonry when the mortar is kept frozen for some time after laying.

The Masons' Department.

Conducted in the Interests of the Mason and the Contractor for Brickwork.

A NOVEL BRICK CHIMNEY.

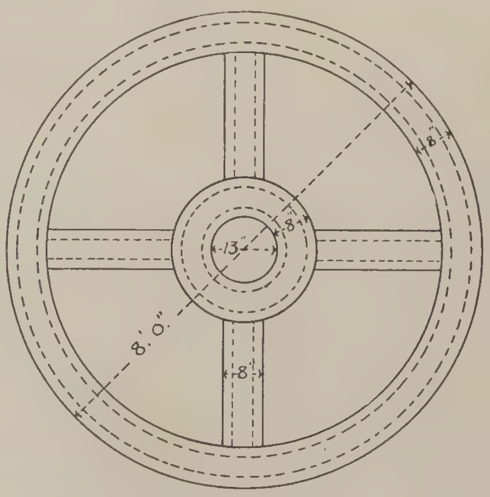
MR. D. J. CURTIS, of Springfield, Mass., had built for him about a year ago, at his brickyard in Chicopee, Mass., a brick chimney, which is really a novelty in its construction and, what is more, has proved a complete success. The following brief description of this chimney will undoubtedly be of interest to those who desire a better draft for their furnaces, but cannot afford a high-priced stack.

Mr. Curtis' plant is situated in the midst of a rich clay bank and in a spot convenient to his boiler. He made one excavation 8 ft. deep and 8 ft. square.

On the bottom of this pit he placed a layer of 2 in. oak plank, and on top of these he laid another layer of the same material, crosswise.

For the inside flue he turned a circular wall of brick 13 ins. in diameter on the inside and 8 ins. thick. Outside of this he turned another and larger circle 8 ft. in diameter on the outside and 8 ins. thick. These two walls he connected by four arms or braces, as seen in the illustration, which were also 8 ins. thick, and were bonded into the circular walls every three or four courses.

These walls were run up plumb to the top of the ground, or about 7 ft., where he changed his 8 in. walls for 4 in., starting them exactly in the center of the 8 in. walls. Incredible as it may seem, he ran these 4 in. walls up 72 ft., where the batter of the outside caused the two walls to come together.



PLAN OF CHIMNEY AT GROUND
DOTTED LINES SHOW 4 IN WALLS
0 1 2 3 4 5
SCALE OF FEET

On top of this a cap or head was put on 8 ft. high, which made the total height of the stack 80 ft. above the level of the ground. The chimney above the level of the ground was built of circular brick, which were easier to lay and made a better job.

In the construction of this stack Mr. Curtis used only the best and hardest brick, and, above all, he took particular pains to see that the bricks were well wet before being placed in the wall. From the bottom of the chimney to the head he used only the best cement mortar, and for this purpose he consumed 35 bbls. of Rosendale cement. The head was laid up with Portland cement mortar, which required 6 bbls. of Portland cement.

The number of brick used in the chimney was a little less than 25,000, and the mason laid these for about $4 per thousand. Counting the brick at $125, labor, $100, cement, $60, sand, planking, and cost of excavating, $30, we have the total cost of an 80 ft. brick stack, $315.

It is the accepted theory, we believe, that the core or inside lining of a chimney should be left entirely free from the outside, as the intense heat brings about an expansion and contraction of the walls, which is apt to make serious cracks in them. But Mr. Curtis' experiment seems to have upset all these theories, as this stack has been used with intense heat for about a year, and it stands to-day as solid and firm as the day it was built. Mr. Curtis will be glad to exhibit his chimney to any one interested, and will try to convince all comers that his idea is practical and economical as well. It is certainly a radical deviation from the usual method.

HOW TO BUILD A CHIMNEY.

SIMPLE as it may seem to build a brick chimney and top it out, it is seldom done in a first-class and workman-like manner. In the first place, especially in wooden houses, the best and hardest brick are selected for the outside walls, or the underpinning in frame houses, and the soft brick and bats are put into the chimneys. Any one with a practical knowledge of the requirements of chimney flues will at once recognize the folly of this method. To be sure, they generally use good brick for the top, but it is up through the inside where there is danger of the fire eating through the soft brick and heating the timbers so that sometimes they become completely charred, and many disastrous fires have been traced directly to this cause.

The use of tile flue lining, which we are glad to note is rapidly coming into general use, overcomes this evil to a certain degree. Many round tile are now placed in square flues, the tile being used for smoke and the four corners of the flue for ventilation.

In topping out a chimney there is a wide difference of opinion as regards the best materials to use as mortar. It has often been remarked that houses built in "ye olden times" had chimneys laid up with simple lime mortar, and when it becomes necessary to tear them down, to make room for more modern structures, they have been found in a good state of preservation; in fact, it is often a hard matter to separate the bricks from the mortar. With a knowledge of this fact, many authorities claim that the masons of to-day do not use as good mortar as the masons of long ago. Their opinion is certainly open to severe criticism. In the first place, they used wood as fuel almost entirely, whereas the common fuel to-day is anthracite coal. As almost every one knows, the gases generated by the consumption of the fuel employed are the prime destructors of chimneys, decomposing and destroying the life of the mortar employed, and causing the softer bricks to chip and flake. Now, the gases thrown off from a wood fire are not strong enough to make any perceptible effect on a well-constructed chimney; but when coal is the fuel we find a far different state of affairs, and just here we find the reason why the chimney built a hundred years ago did not fall to pieces in a few years, like those of the present day. Having found that the gases, or condensation of gases, are the chief factors in the destruction of the chimney, we must employ those materials least susceptible to their ravages, and the experience of some of the most practical mason builders in the country has suggested the following rule: Use only the best and hardest brick throughout the entire chimney, laying them in best lime mortar to roof, and be particular to fill all joints FULL. Above the roof use mortar composed of one part lime and four parts cement, with sand enough to work smooth. The plainer the chimney top is in design the better. Saw-tooth work and similar ornamentation should be avoided, and the largest chimneys should not be drawn out at the head more than eight inches in each direction. Keep the inside of the flue straight and smooth. Change the bond in setting out the projections in the head to avoid the use of small pieces, or "Dutchmen." Do not make the top course smaller than the shaft of the chimney. On top of the brickwork put a stone coping and fasten the dowels with melted lead, and on top of this coping put a flat, smooth stone, supported at each corner by small blocks of stone, whose height must depend on the size of the flue or flues.

A strict observance of these rules will give as a result a well-built, safe, and durable chimney, which will not be affected by the weather or gases nearly as soon as those built in the ordinary manner.

BUILDING A LARGE DAM.

ONE of the largest, if not the largest, dam in the New England States is now in the course of construction at Holyoke, Mass., and is to hold in check, for the use of innumerable mills and factories, the mighty waters of the Connecticut River. To build such a dam is no small undertaking and requires a large amount of time and money. It is going to take about three years to complete this work, and, though the contract price has never been made public, it is understood it will cost considerably over half a million dollars.

No new gate-house will be needed. The dam in high freshets must sustain a pressure of about 37,500 lbs. to the lineal foot, acting with leverage of 13⅓ ft. Under such circumstances the structure will have a factor of safety of four. The cement mortar is composed of one part cement to two parts of clean sharp sand. The concrete has two parts of broken trap rock to one part of the cement in the mortar.

There will be used 50,000 bbls. of Alpha Portland cement, 34,500 yds. of rubble masonry, and about 14,000 yds. of granite.

Much work has been accomplished during the past season, and in some places the huge mass of masonry is just beginning to rise above the level of the river-bed, which gives a general idea of the undertaking.

This is the third dam to be built across the river at this point. The first was finished in November, 1848, but when the gates were shut and the water was allowed to accumulate the dam was unable to stand the pressure and rolled over and went down stream. It cost about $40,000, and was a total loss. The next one, which is now standing just above where the new one is being erected, was finished in 1849, and cost then $150,000. In 1870 the present big apron of the dam was put on, that is, the long slope that extends down the river from the dam. This cost much more than the dam itself, or $250,000.

From time to time repairs have been needed on the old dam, and have been made, but the need of a new dam has been foreseen for some years, and preparations have been going on for some time toward that end.

The Water Power Company made the necessary excavations for the work, and then called for bids for constructing the dam. There was considerable competition, but the Fruin-Bambrick Construction Company, of St. Louis, succeeded in getting the contract.

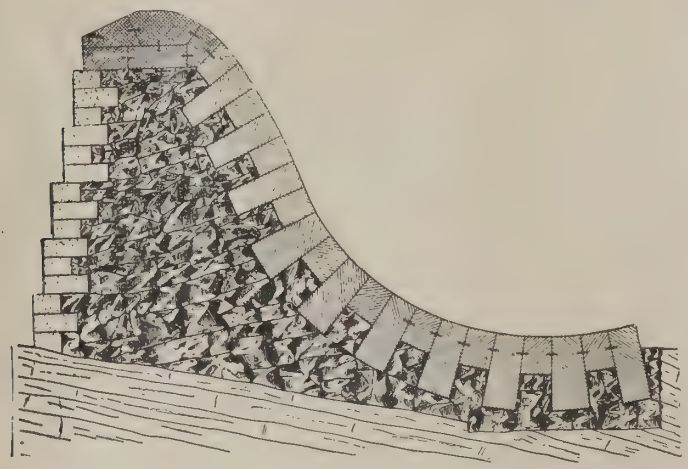
Standing on the Holyoke side, near the gate-house, the whole work can be seen at once. The new dam is about 130 ft. below the old wooden one, and what little water flows over or leaks through the old dam is run off through a long narrow channel, cut and blasted out in the bed of the river. The collecting of the water in this channel has left the rocky bed of the river dry and bare, and a rough-looking scene it is.

Probably the first thing one notices is the cable road over the river, ending in the big wooden skeleton towers at either end. There are five cables running from tower to tower, considerably over 1,000 ft. The great center cable weighs 12 tons, the other four, two on each side of the large one, being somewhat smaller. The towers are built to stand a strain of 200,000 lbs. On these cables are carried out men, cars of cement, great blocks of stone, — anything, in fact, that is needed. When the carrier is on the Holyoke side of the river there can be seen a number of loops of chain, hanging down from the cable behind it, which grow less in number, one by one, as the carrier goes across the river. These chains are fastened to traveling pulleys which support the haul cable, which, of course, has to lengthen and shorten as the car goes out and back.

When the car starts out the pulleys all go with it, but when it has gone a little way the pulley nearest the starting point is stopped by the straightening of the loop of chain which connects it with the tower; and a little farther out the second pulley is stopped by the loop which connects it to the first, and so on across the river. Then when the car is across the river, the pulleys, at regular intervals all the way across, support the haul cable. A new scheme, however, is being put in operation now for supporting the haul cable. Instead of these pulleys being connected by chains which stop once in so often, they have two wheels geared like bicycles. The cable on which they run will pass between these two wheels, and the speed will be regulated by the rapidity with which these wheels revolve.

The traveler with the highest gearing will come right next to the car itself, and will travel nearly as fast. The one next behind will not be geared quite so high, and will not travel quite so fast as the one in front of it, but a little faster than the one behind. This difference in speed will regulate their relative positions on the cable when the car is crossing the river, and will do away with the long, dangling chains, which were apt to get in the way.

The first thing one notices in looking down into the river-bed is what looks like a long, narrow canal running across the river right under the cable. This is where the new dam will stand when completed. The bottom of this excavation has been filled with concrete, and on top of this the workmen are busily engaged in laying stone for the upper side of the dam. The new dam will on the north or upper side be practically perpendicular, while on the south side it will slope off in a curve, which has been carefully calculated so as to offer the least resistance to the water as it flows over it. At the foot of the dam, or toe, as it is called, there will be a slight rise, so along at the lowest part there will be a shallow basin.



As can be seen from the illustration, the shell of the dam is to be of block granite filled in with rubblework. The stone for the rubblework has been taken from the river-bed below the dam. The new dam will be 38 ft. high and 54½ ft. wide at the base.

The scene along the line of the dam is a busy one. Two or three steam derricks are placing the larger stone, and an engine is at work pumping the water out of a section of the canal, preparatory to putting in the concrete, this section being cut off from the rest of the canal by a coffer-dam of sand bags.

A line of men with wheelbarrows are carrying out sand for the mortar, while overhead rumbles the great car with its load of stone or barrels of cement. There is quite a signal corps used in manipulating this car, by the way. When the car is over on the side opposite Holyoke a man on shore will wave frantically with a red or a white flag to a man on a platform half way across the river, and he, in turn, waves one just as frantically to a man perched up beside the gate-house on the Holyoke side. This man signals with his hand to the engineer, who hoists, lowers, starts, or stops the car accordingly.

Another season will see the wall of the dam rising above the rocks around it, and onlookers will then be able to get a better idea of the work. Then the massiveness of the foundation and the gracefulness of the curve of the south side can be seen and appreciated. The amount of work which will be done this winter will depend somewhat on the weather. Probably granite will be arriving all winter, and if the weather be mild some work will be done on the dam.

There has been some delay because of the difficulty of securing granite of the proper quality, and some carloads have been rejected. But the work is now progressing rapidly, and probably within the allotted time Holyoke's new dam will be completed.

CRACKS IN BRICKWORK AND PLASTERING — WHAT CAUSES THEM, AND HOW THEY MAY BE PREVENTED.

BY A. H. DYER.

(*Continued.*)

FIG. 15 shows the end wall of a shop building built upon a continuous footing of uniform width. Like all of the previous examples, this is an exact representation of an actual case, and plainly shows the usual result of this method of construction; it is, however, entirely different from any of the former examples, inasmuch as it is *not* a case of *too much foundation.* If the entire wall had been built to the uniform height of 16 ft., the footings would not require to be increased at any point, but would need to be cut out below the opening, as shown by Fig. 6; but in this case we have above the center of the large opening a 12 in. wall, 10 ft. higher than the top of the wall at either corner and tapering from the center line to each corner, as shown. The load at the corners is figured at 7⅔ lbs. per square inch, and at this rate the net weight of the brickwork alone (62,070 lbs.) would require a footing of the uniform width of 20 ins. to be about 33⅔ ft. long, or 3⅔ ft. longer than the width of the building. The footing at lines E and F is already overloaded, even though we assume that the entire area of footings between these lines are loaded in the same proportion as the footings between the opening and the corners; therefore, a "cut out" below the opening would do no good unless the width of the footings be increased near the jamb line of the opening. In the first

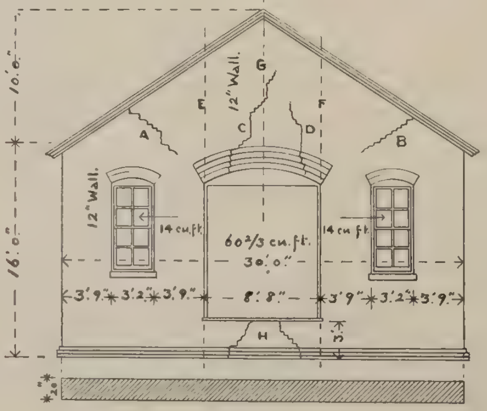


FIG. 15.

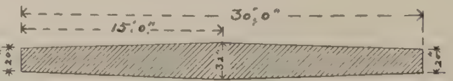


FIG. 16.

place, it would be well to ascertain what area of footings would be required if the entire wall were solid; taking the height of wall at one of the corners, we find the load per square inch to be 7⅔ lbs. with a footing 20 ins. wide; then, taking the height of wall at G, we find that in order to have a load of 7⅔ lbs. per square inch at this point the footing should be approximately 32 ins. wide, and, figuring the *total* weight of the wall (72,000 lbs.) at 7⅔ lbs. per square inch, we find that a footing as shown by Fig. 16 would be practically a uniform one, *provided there were no openings.* But to have a uniform footing for the wall *with* footings we must cut out the center and increase the width of footings at each side of the "cut out," as shown by Fig. 17. Now, to prove that we have made no serious error in our calculations, we will take the total area of footings in Fig. 17, which we find to be 8,064 sq. ins., at 7⅔ lbs. per square inch, and we have 61,823 lbs.; the net weight of the wall after deducting 9,930 lbs. for the three openings is 62,070 lbs., or 246 lbs. more than the above, but, as this is only a slight difference in the aggregate, and also considering the fact that the "cut out" takes out at least that much weight, it will be seen that Fig. 17 has practically the required area of footings for a wall like that shown in Fig. 15.

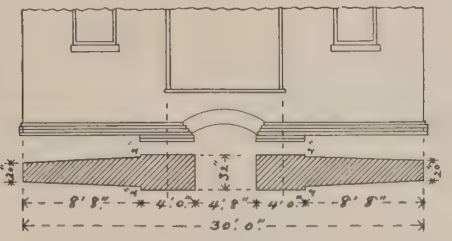


FIG. 17.

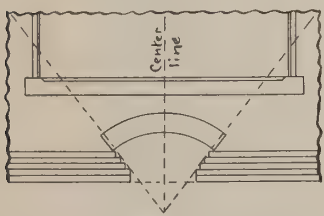


FIG. 18.

It may be noticed that there has been no special reduction made in the footings below the window openings; in this particular case the reduction required would be so little that it would be better not to attempt it in the usual way, but it will be seen that the *total area* of footings is no more than is required to support the *net* weight of wall at the rate of 7⅔ lbs. per square inch. Fig. 17 has an area of 864 sq. ins. more than Fig. 15, and in place of "H" has a "cut out" 4 ft. 8 ins. wide, while the footing at the ends is the same width in both cases. In Fig. 15 no fractures are shown in the vicinity of the window openings, and they do not often occur in a case of this kind unless the openings are quite large or located but a short distance above the footings.

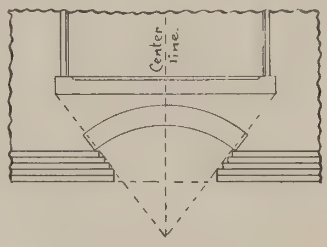


FIG. 19.

Cracks C and D started at the under side of the arch and worked upward, while A and B began at the top of the wall and worked downward, but all of them worked toward the center line.

In cutting out under wide openings that are only a short distance above the footings, care should be taken not to have the sides of "cut out" too far from the "jamb line," as shown in Fig. 18; but the limit should be as shown in Fig. 19; *i. e.*, a line touching the corners of projections and extending upward as shown should clear the end of sill.

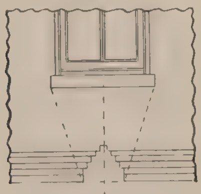


FIG. 20.

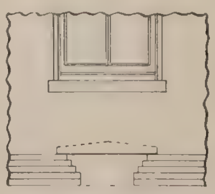


FIG. 21.

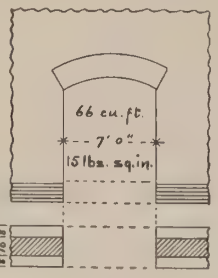


FIG. 22.

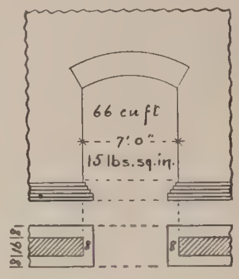


FIG. 23.

In Fig. 18 the "cut out" should be made wide enough so that the dotted lines would clear the ends of sill, and then the footing at each side of the "cut out" should be uniformly widened enough to gain the required number of square inches, and in a manner similar to that shown in Fig. 17. Arches over "cut outs" should spring from the top course of footings where practicable, but in case of insufficient room they may spring from bottom course, as shown by Fig. 17, but it would be well to avoid this if possible. In case of a very narrow "cut out," and when there is but little weight directly above it, the footings may be corbeled over the opening, as shown in Fig. 20. For large openings steel "I" beams of suitable size could be used to advantage, or a cast-iron ribbed lintel could be used, as shown by Fig. 21.

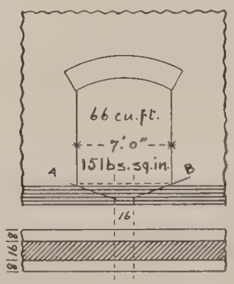


FIG. 24.

The architect or builder who extends the footings full width along the entire area beneath all window openings is very apt to go to the opposite extreme when laying out a basement door opening, whether in an outside wall or a partition wall. Sometimes the footing is cut off on a line with the jamb of the opening, as shown in Fig. 22; in this case (provided the weight of the solid wall gave a load of 15 lbs. per square inch) the area of footings would require to be increased about 2,195 sq. ins. In most cases, however, the footing projects into the opening the same as it does on each side of the wall, regardless of the size of the opening or the width of the footing, and as shown in Fig. 23, in which case the area of footing is 1,664 sq. ins. less than it should be. In many instances the footing is *continuous*, as shown in Fig. 24; by cutting out 16 ins. in width from the center, as shown by the dotted lines, the required area would be obtained, but how much of this area as shown below lines A and B would have a uniform load of 15 lbs. per square inch? The cause of many of the unsightly cracks to be seen in interior or exterior walls may be traced directly to such methods of construction as shown by Figs. 22, 23, 24; if in an outside wall and located very near a corner of the building, either of the above methods will quite frequently afford a fine opportunity to demonstrate the theory of making foundations safe by the use of iron rods.

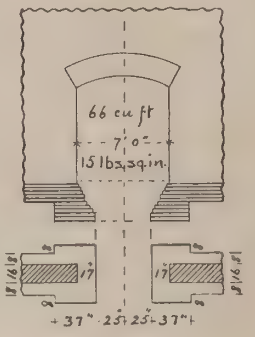


FIG. 25.

Fig. 25 shows a way to provide a uniform footing which may be varied to suit the requirements; for instance, if it is desired to have a finished floor lower the top of upper footing course, the top courses of footings can be even with the jamb line, and the number of courses and projections below be increased accordingly.

(To be continued.)

Recent Brick and Terra-Cotta Work in American Cities.

A Department Devoted to the Interests of the Manufacturer.

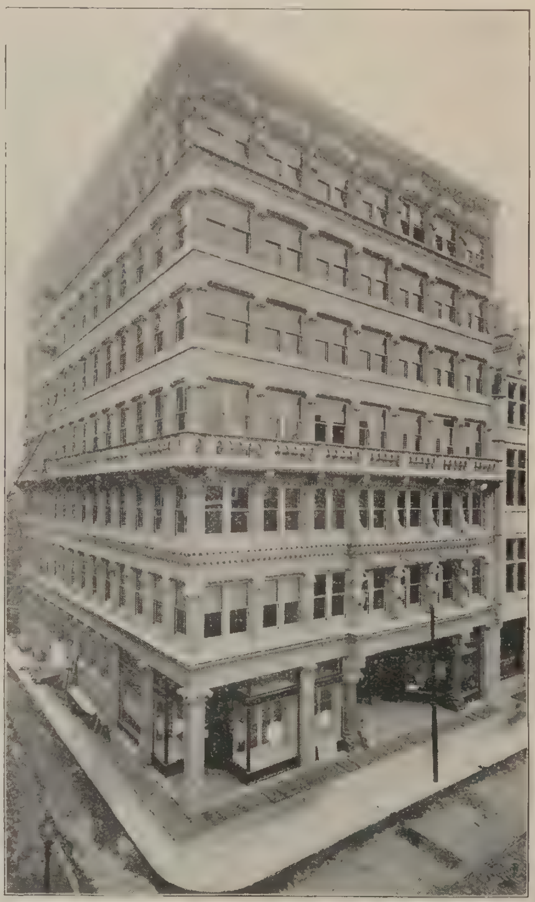
JUST as a composite-photograph is supposed to blend all the character traits in all the many individuals whose negatives are used into one generalized individual whose picture shows none of the extreme markings of any of the individuals, and yet have traces of minute detail to such an extent that the character of each individual can be traced as affecting the resulting picture, so to an extent a modern building, the product of the exertion and effort of thousands of individuals, stands as a stately composite whole, speaking most loudly, indeed, of the individualism of the architect who planned it, whose eyes looked way out into the future and saw it in the trees of the forest, in the ore in the mountain, and in the clay of the valley. Yet, while it speaks in clarion tones of him who penned it, it still has a whisper for each humble worker who honestly and consistently labored for its betterment.

An apt illustration of this is the "Bowlby Building," opposite the Ryan Hotel in St. Paul, just completed, some illustrations from which are here shown. The quick, skilled eyes of the architect, Mr. Cass Gilbert, had looked past and through the shabby buildings that recently cumbered this ground. His mind had gone out far into widely different lines of manufacture. He had considered the products offered and the points in which each product excelled, as well as the uses required, the wishes of the owner, and, in fine, all the necessities of the case. His brain wrought out a scheme of construction that combined strength and durability as well as utility and beauty. Calling then to his aid the well-known contractor and builder, Mr. George J. Grant, and working together, they brought the labor of the miners, smelters, riveters, and smiths as embodied in an iron skeleton, which was in turn covered with the lasting and beautiful sculpture of terra-cotta, combining its artistic lines and delightful color effects as it came fresh from its fiery baptism. The body color of the whole building is just shaded off a white, a very light cream, while at the top story some pure white and a little richer buff is used. In the frieze there are fourteen cherubic figures, finished in colored, shaded glaze. Each of these stands upon a bracket and rests against a colored glazed medallion. Notwithstanding the fact that the whole building had to be put up in a great hurry, it seems to have had none but gratifying criticism, as being at least one of the finest examples of modern construction in the Northwest, and it is more than probable that the fact that all the workers have exhibited an interest in its rapid and skilful completion, with an absence of wrangling over technical points which has made the whole matter a pleasure to all concerned, has contributed not a little to the result.

W. D. GATES.

PHILADELPHIA. — The dwelling builders have had things their own way for the few weeks just passed. There were many operations, and some large ones; but, as usual, there seems to be no desire to improve the dwelling-house architecture of the city by those who build three fourths of the dwellings, — the operative builders.

It would seem that there should be some desire to do better when there are new conditions imposed upon them by the revised building laws and the increased force of inspectors; but there is still the same bad wall, and the usual amount of half-burned bricks are yet to be seen. Artistically, they are worse than before, for some few strive for variety by changing the design (as they call it) every few houses; there will be four with Pompeian fronts, then four with red, and so on in alternation, all of them frightfully bad in design, and capped with the same very cheap galvanized cornice. We fear it will ever be thus.



FRANKLIN BUILDING, PHILADELPHIA,
Furness, Evans & Co., Architects.

In the larger contracts, however, there is a desire for something very much better than usual; and what is even more noticeable is the desire for speed. It no longer takes two years to put up a large building, as was clearly demonstrated in the erection of the Franklin Building, which is now pretty fully occupied, upon a site where eight months ago stood a number of old and very insignificant buildings.

Eight months, however, does not mark the time required for the erection of this building, for it has been ready for occupancy for some time. The demolition of the old buildings commenced on the 12th of last March, the first concrete for the foundations was laid on the 14th of the following April, and the work progressed so quickly from that time until the completion of the building that one could see it grow; and it seemed to grow without much effort, so well was the work managed. On September 14th one of the stores was occupied for business.

The entire building, from the time of the laying of the first concrete, was completed and thrown open to the public in the surprisingly short period of five months.

It is well erected, thoroughly fire-proof, and equipped with every modern device known to the profession, making it one of the largest and best office buildings in the city.

The building was erected for W. W. Frazier, Esq., is situated upon the corner of Twelfth and Lawson Streets, and is entirely occupied by offices, except the first story, which contains stores; it is constructed from iron, terra-cotta, and cement, the entire fronts being of terra-cotta, which is beautifully modeled, and is the work of Stephens & Co. The caryatids which support the second story are especially effective, and were designed by the eminent sculptor, Carl Bitter; the terra-cotta balcony around the entire building at the fourth floor is also a very nice feature and serves to relieve the monotony of that part of the design. The interior, as before said, is strictly fire-proof, the flooring is of cement concrete and twisted steel rods, a patent construction controlled by the Fire-proof Flooring Co., of this city, while the elevators are the work of Morse, Williams & Co.

To the architects, Messrs. Furness, Evans & Co., is due the credit for the management of the work; it was entirely under their supervision from the beginning, even to the letting of the contracts, which, it is well to say, were all restricted to Philadelphia firms.

This, we think, should go a great way toward removing the untrue stigma of *slowness* from Philadelphia, if we consider the marvelously short time consumed in the erection of such an elaborate building as the one in question. Can cosmopolitan New York or hustling Chicago beat this time record?

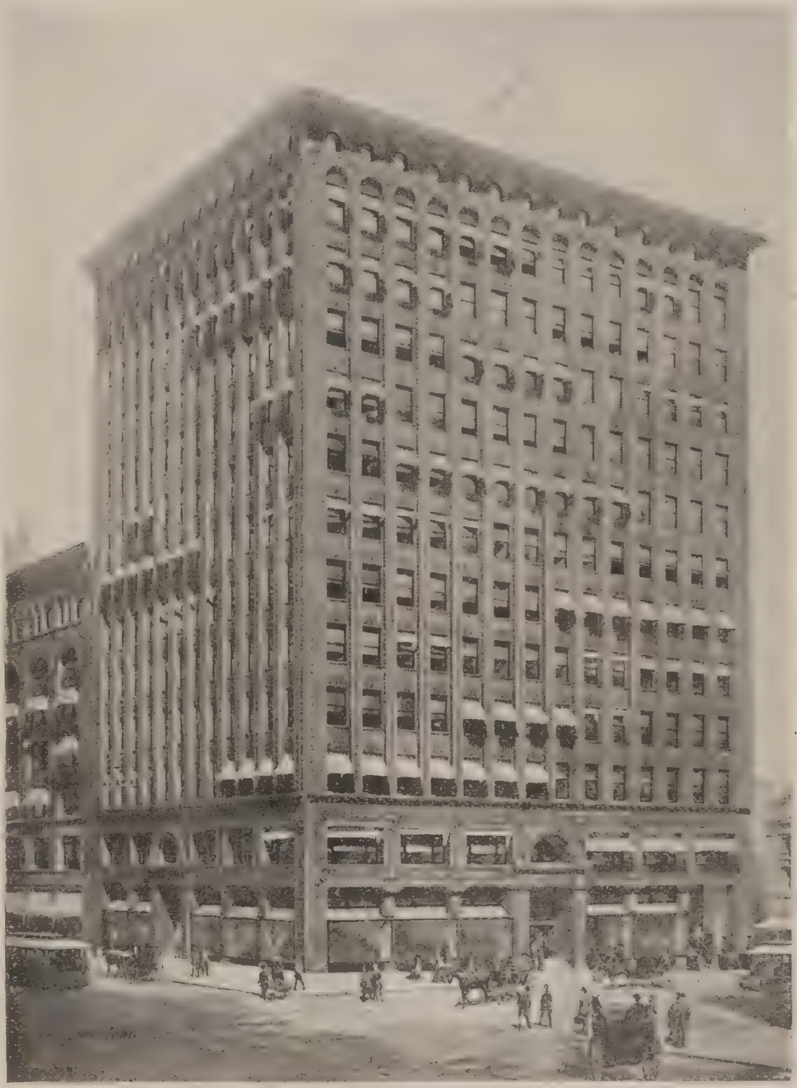
The committee to judge the designs submitted for the Museum in Fairmount Park have been appointed, and have accepted; they will report on the 15th of the present month. They are as follows: —

Mr. C. C. Harrison, provost of the University of Pennsylvania.

Architects D. H. Burnham, of Chicago, Stanford White, of New York, and Jos. Wilson, Philadelphia.

Experts not architects, Professor Ware and Mr. J. H. Johnson.

If the park commissioners will allow themselves to be governed by the report of this committee there need be no fear of the proper outcome of the competition.



GUARANTY BUILDING, BUFFALO, N. Y.,
Adler & Sullivan, Architects. Largest all terra-cotta building in America. Terra-Cotta furnished by the Northwestern Terra-Cotta Co.

CHICAGO. — It is to be hoped that all young architects will take an interest in the proceedings of the annual convention of the American Institute of Architects, whether they are members or not. May it be hoped, also, that as a result of such interest and back of this, as a result of the feeling in the profession at large which found expression at the convention in St. Louis, in the papers of Mr. Cook, of Memphis, and Mr. Patton, of Chicago, this year may mark a large stride in the advancement of the architectural profession.

It is enough to make an architect blush with shame to hear architects, themselves above reproach, admit that a majority of the architects in Chicago are not honest men. If it is true (and who doubts?) that there are many men who accept 1 or 2 per cent. for a fee, and then get 5 or 10 per cent. through the contractors, without the owner's knowledge, and if it is true that there are enough bad men in the Institute of Architects to disgrace that organization, then the more pressing the need for good men to exert themselves, join the institute, and help to reform it. Architecture is a learned profession, and it ought to be a dignified one with a strict code of ethics on just as high a plane as law or medicine.

Chicago's activity in building was greater in October than it has been at any corresponding time since the World's Fair. One point lately noted is that the building of single houses for sale and rent is considerably on the increase. Still, it is not easy to perceive that flats and apartment buildings are any less numerous.

The eighteen-story Fisher Building was slow in getting started, but when the steel came it went up like the bean stalk. The open steel skeleton stood fourteen stories high before any masonry walls or floor arches were begun, and then the walls were started in the fourth story first.

The record shows a long list this year of buildings for industrial purposes. One of the best of these noted by the writer is a $100,000 manufacturing building for the Western Electric Company; Treal & Foltz, architects. Laying brickwork in cement mortar was a part of this building not common in Chicago. A good feature, too, is the accommodation of work benches in a series of bay windows which secure fine light and save or gain floor space.

BUFFALO. — There is little new to be said of the realty market from the investment standpoint. The encouraging signs of predicted activity have alone made the market interesting.

The Niagara Falls power negotiations with the city are still in embryo, giving nothing definite to renew confidence in investors.

Shrewd investors are basing calculations upon an early settlement of these power negotiations and tendencies to cause spring developments, and have been carefully selecting their land for a busy spring.

Building at the Falls is principally factories. Syndicates and manufacturers here obtain quite a few options.

Architects report nothing of special interest. The principal plans are new factories and apartment houses, outside of those buildings now in course of erection here enumerated.

TERRA-COTTA DETAILS USED IN THE GUARANTY BUILDING.

House and stable for R. K. Root; cost, $35,000; Staten Island Terra-Cotta Lumber Company's cream brick; McKinn, Mead & White, architects.

House and stable for Charles Williams; cost, $30,000; red brick, white joints; McKinn, Mead & White, architects.

House and stable for J. H. Smith, 76 ft. by 110 ft.; cost, $50,000; Swan & Falkner, architects.

Erie Savings and Loan Association, terra-cotta front; Lansing & Belerl, architects.

Wards H, I, and S, to Buffalo State Hospital; cost, $212,000; Green & Wicks, architects.

Twentieth Century Club; cost, $40,000; Sayre & Fisher salmon pink brick; Green & Wicks, architects.

Lafayette Church; brown sandstone; Lansing & Belerl, architects.

Fuchs Building; Hydraulic Company's brick; Bethune, Bethune & Fuchs, architects.

Mrs. White's residence; Sayre & Fisher cream brick, white terra-cotta, Northwestern Terra-Cotta Company; George Cary, architect.

Marlborough Flats; cost, $20,000; cream brick and dark red terra-cotta trimmings; F. W. Humble, architect.

TERRA-COTTA DETAILS USED IN THE GUARANTY BULDING.

House and stable for Mrs. Violetta Pierce (frame and shingle), colonial; cost, $24,000; Green & Wicks, architects.

Public School No. 58, competition; cost, $45,000; August Eisenwein, architect.

Public School No. 23, competition; cost, $45,000; F. W. Caulkins, architect.

ROCHESTER. — The outlook for further building operations this fall is rather blank. Not many new jobs are on the boards in any of the offices, and it looks as though brickbuilders will have to content themselves with building brick chimneys until next spring, when it is expected that they will be treated to something better.

Messrs. Ellis Bros. and Kelly & Headley are preparing plans for manufacturing buildings which will not be built until spring.

Mr. F. A. Brockett has just let contracts to Ford, Welsh & Kenny for the erection of a three-story brick store building, to be built on Monroe Avenue. New York Hydraulic-Press Brick will be used.

Messrs. Fay & Dryer, architects, have let contracts to Chambers & Casey for the erection of a four-story manufacturing building, to be built for Proctor Estate, and to R. Kreigh for the erection of a three-story store building, to be built on Lyell Avenue, and are about to let contracts for a residence for Mr. R. D. Richards, to be built on Buckingham Street. New York Hydraulic-Press Brick will be used in first story, and also on fronts of the other buildings.

C. F. Crandall, architect, has let contracts to Stallman Brothers for a five-story manufacturing building, to be built on Elizabeth Street; Sturtevant system of heating and ventilation, press-brick, etc., slow-burning construction. All interior walls are of brick, and the building generally will be one of *the* best manufacturing buildings in the city, and every appliance and all materials will be of the very best.

Mr. Oscar Knebel, one of the best-known architects in the city, has been nominated for member of the executive board, and it is hoped by architects and builders that he will be elected, as it would probably help in changing the poor system of letting public work to the "architect with the pull." Mr. Knebel has been nominated by both the Good Government Club and the Democratic Party.

DETROIT. — The county auditors have advertised for proposals for the new jail and sheriff's residence. These gentlemen may think they are guarding the interests of the tax-payers, but if their scheme is carried out it will look very much like a case of boodling.

In the first place, only prison-builders are invited to compete for the new building to cost $150,000.

There is no such trade in the United States as prison-builders, that is, firms who make a specialty of prison-building. There are manufacturers of jail cages, but they do not enter into the architectural features of the building.

And in the second place they are to specify Portage Entry or Berea stone; both of these stones are represented by the Malones, of Cleveland, O.

Each bidder bases his proposal on his own plan, so the adopted plan has only one bidder. It is required that each bidder deposit a certified check for ten per cent. of the amount of his proposal. This will shut out some competent contractors.

The advertisement reads that "no commission will be paid for plans." No firm should hold the position of architect and contractor.

It is well the matter is being looked into, as we are about to build a $1,000,000 court-house in addition to the jail.

Their defense is that they have had a number of exclusive jail-builders before the board before they had advertised.

Now, A. L Bours has stated in a daily paper that he will pay one dollar each for the names of exclusive jail-builders. They then refer to one, the Pauly Jail Building & Manufacturing Co. Mr. Bours in response says, "There is one Pauly, an architect who has a brother that superintends the manufacture of jail cages and other articles of iron." So if the supervisors desire to clear themselves of any suspicion, they should adopt the customary methods.

Not only is curiosity aroused by the rapidity with which Mabley & Co.'s new fourteen-story building progresses, but the peculiar method of building the walls of a large building entirely of hollow terra-cotta, new to Detroit.

TERRA-COTTA DETAILS USED IN THE GUARANTY BUILDING.

A gentleman was heard to remark that he would not have an office in that building if he were to get it free. Little need he worry; offices will not be offered free, neither is the building going to fall, as it is constructed of the best material that could be used for that purpose.

The terra-cotta is furnished by the Northwestern Terra-Cotta Co. They are now only up to the seventh floor with the steel, and to the fifth with the terra-cotta; still, the building is to be closed in by January 1.

The Goebel Brewing Co. will build a new brewery 45 by 200 ft., five stories high, surmounted by an ornate tower of brick and marble; in addition to this they will build a new wash-house and bottling works.

E. A. Walshe & Son have plans for a factory and office building to be erected by the Universal Elevator Co.

Architect A. C. Varney has made plans for a handsome press brick block for D. J. Campau, corner of Cass and Michigan Avenues.

Arthur E. Clark, representing the United Alkali Co., which is a combination of half the companies in England, has been looking over the salt district and obtaining options on a large tract of property. It is announced that the present plan of the trust is to do some extensive building in that district. The company is capitalized at $42,000,000, and if they establish themselves at Detroit practically all the manufactures of Europe will be represented here.

Messrs. W. H. Ashwell & Co., architects, have completed their plans for a system of water works and electric lighting plant for the log cabin subdivision; work of construction will be commenced at once; buildings constructed of brick, including a reservoir of one hundred thousand gallons capacity; bricks of reservoir to be laid in cement mortar.

John Scott & Co., architects, are making the plans for the new Women's Gymnasium for the State University, which will cost about $70,000; also a $20,000 residence for Dr. Mortimer Wilson.

MINNEAPOLIS.—The Chamber of Commerce will soon be ready for occupancy again, repairs having been pushed under supervision of Contractor Haglin.

The masonry of our new city hall and court-house was completed October 26, the last stone being laid at 4.31 P.M., in presence of the architects, superintendent, contractors, and commissioners, with appropriate ceremonies and subsequent "liquidation." I shall give you a complete description of this great undertaking in a short time. Nothing remains to be done externally, but the apex of tower, which will be of iron, terra-cotta, and tiles, reaching to a total height of 340 ft. above street grade.

The Architectural Sketch Club is holding an exhibit at present of drawings, sketches, etc., with THE BRICKBUILDER competition drawings for a city residence as a nucleus. After scouring the local architects' offices, about two hundred sketches were "dug up," which make an extremely artistic and satisfactory display of the abilities of our various offices and has attracted considerable attention from the public. Mr. S. J. Hewson, general manager of the Northern Hydraulic-Press Brick Co., tendered the club the use of his display room for this exhibit, and has also generously offered the use of same during the coming winter for their classes and meetings. The result will undoubtedly be a thorough reorganization of the club for some good and profitable work this winter. It is the intention to hold a general exhibition before next spring of the club's efforts in the way of studies for fireplaces, city fronts, terra-cotta detail, etc. There are enough draftsmen of ability here to insure a good showing.

The State Capitol Commission has finally decided upon an architect for the new capitol building, having chosen Mr. Cass Gilbert, of St. Paul, for the position, a decision that meets with hearty approval with the profession generally and assures us a structure skilfully planned, constructed, and designed. After two competitions and the submission of ninety-seven different designs, the commission has selected a plan, which they will, of course, alter considerably before a satisfactory result is attained. Here is an excellent example of the competition evil. Although fifty-six designs were submitted in the first competition, none were deemed worthy of execution, although there were designs there fully as worthy as those given prizes in this second competition, as is freely conceded. Politics seemed to rule, also the inevitable "pull," and the result is doubly satisfactory, when one considers what a poor choice might have been made.

Work will be pushed on the foundations as soon as spring opens, and it is expected that the superstructure will be under way before next fall. Geo. Mann, of St. Louis, drew second prize; Traphagen & Fitzpatrick, of Duluth, third prize; Clarence H. Johnston, St. Paul, fourth prize; and Harry W. Jones, of Minneapolis, fifth prize.

OF INTEREST.

MESSRS. MEEKER & CARTER have recently taken orders to furnish architectural terra-cotta for the following buildings: Ayer Building, Broadway and Leonard Street; Wadsworth Building, Union Square; and apartment house, 75th Street and Columbus Avenue, New York City, and public school No. 110, Brooklyn.

THE GRUEBY FAIENCE COMPANY, whose new advertisement appears on page xx, furnished twenty-one faience mantels executed from original designs for "The Bolkenhayen," Fifth Avenue and 58th Street, New York City, of which Alfred Zucker is the architect. These mantels contain some very fine work in two colors, and have been the object of much admiration.

VALUABLE information to the readers of THE BRICKBUILDER regarding clay deposits, brickmaking machinery, locating, erecting, and equipping press brick plants may be had by addressing the "Kulage Machine Works," on College Avenue and North Broadway, St. Louis, Mo. The celebrated "Triumph" Press, which is said to be the most perfect and successful dry clay brick press in existence and upon the market, and the "Triumph Gathering and Loading Machine" are manufactured by the Kulage Machine Works.

MESSRS. E. A. PHILLIPS AND A. PENTECOST, architects, have associated themselves under the above style and taken offices in the Fornes Building, Buffalo. They will make a specialty of heavy construction and building requiring mechanical skill. Catalogues are desired.

THE TIFFANY PRESSED BRICK COMPANY have secured the large contract for the new Century Building, St. Louis, Mo.

They have recently received the following most flattering indorsement for their enameled bricks:—

CHICAGO, Sept. 28, 1895.

J. VAN INWAGEN, ESQ.,
President Tiffany Pressed Brick Co., Chicago.

Dear Sir,—We have used large quantities of the "Tiffany" Enameled Brick and believe them to be, in quality and finish, fully equal to the best English product. We have found it an especial convenience to be able to obtain special shapes without delay.

Very truly yours,
ADLER & SULLIVAN, *Architects.*

THE art of brickmaking has been so perfected that, by the means of their machinery, the "Kulage Machine Works," located on College Avenue and North Broadway, St. Louis, Mo., claim to be able to produce the finest and highest grade of pressed front and face bricks at *less cost* than the average cost of common slop or mud bricks. The readers of THE BRICKBUILDER may profit by asking for further information direct to the Kulage Machine Works.

MESSRS. MEEKER & CARTER have been appointed sole agents for the American Enameled Brick Company, and will handle their entire output, which amounts to over two million bricks per year. These bricks have met with an unqualified success and are being specified by many prominent architects.

Brickmakers, Your Interest
demands of you that you peruse the following
Announcement:

WE manufacture the Kulage Brick Press, which is the celebrated "Triumph" Dry Clay Press Brick Machine.

We guarantee that this press has not its equal. The "Triumph" has a capacity up to 35,000 plain or shaped pressed bricks in ten hours—has four distinct or quadruple pressures—has solved the problem of a twin, or top and bottom pressure without the center seam streak or granulation; is simpler—stronger—and built upon better scientific principles than any other dry clay brick press on the market. The price of a "Triumph" press is $5,500, which entire amount may be saved or gained during the first year in the superior quality of its product, capacity, and economy of operation, and comparing same with other presses.

We construct and equip brick plants of any capacity complete, and in this connection would say that we manufacture the "Triumph" Gathering and Loading Machine—also a money-maker for the brickmaker. This machine gathers the previously plowed and dried clay from the field, and loads same into carts or wagons. With two or three horses and one driver, its capacity is the gathering and loading of as much clay as twenty men with shovels would do. The profits and advantages obtained by the use of this machine are enormous.

Valuable information for progressive brickmakers—capitalists—and syndicates may be had by addressing:

Kulage Machine Works,
College Avenue and North Broadway, St. Louis, Mo.

HERE IS ONE

Representation of a FIREPLACE MANTEL. Our Sketch Book, containing 39 others, will be sent you on application.

JUST THE THING

FIREPLACE MANTELS
MADE OF MOULDED BRICK

In such Colors as Red, Cream, Buff, Pink, Brown, and Gray. These Mantels cost no more than other kinds, but are far better. They are easily set, and have a richness and simplicity of effect which is decidedly pleasing.

PHILA. & BOSTON FACE BRICK CO.,
No. 4 LIBERTY SQUARE, BOSTON, MASS.

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THE BRICKBUILDER.

AN ILLUSTRATED MONTHLY DEVOTED TO THE ADVANCEMENT OF ARCHITECTURE IN MATERIALS OF CLAY.

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THOSE of our readers who were familiar with the early struggles for existence incidental to the founding of this paper will remember the serious consultations which were held with our friends as to the advisability of such a periodical and as to whether the building trades having to do with clay products had reached a state of sufficient development to call for a journal in this country devoted exclusively to their interests. The continued existence and prosperity of THE BRICKBUILDER is of itself an evidence to our minds not only that we as a paper were needed, but, which is of vastly more importance to the community and to the trades we represent, that the brick and terra-cotta industries are in a flourishing condition and are of sufficient magnitude and importance artistically, architecturally, and financially to warrant the special attention which we have always endeavored to give them. No one can look over the building field without being impressed with the enormous expansion which has accompanied the development of these manufactures. Brickmaking is no longer merely a trade; it has become both a science and an art, and whereas the time is not very long past when bricks were used for building chiefly for reasons of economy in first cost, the humble material being despised by comparison with the more expensive media of stone or iron, brick is now recognized as being, all things considered, the best material for a modern commercial building; best not only from the constructive point of view, but also from the standpoint of the artist who considers materials not of themselves so much as for the functions they fulfil in the completed structure. We imagine terra-cotta manufacturers are apt to assume that a species of hostility exists between themselves and the architects, due to a divergence of opinion as to the proper use of terra-cotta in its various modifications and as to what constitutes first-class material. Where the feeling exists it has arisen very largely because that, by reason of modern business methods, the terra-cotta manufacturer, who should be in the closest touch with the designer, comes to the building at best only as a subcontractor, and often never sees the architect or owner at all. We are convinced, however, by our constant interchange of views with both architects and manufacturers, that the differences are less real than imaginary, and that the feeling of the brick and terra-cotta makers generally throughout the country is one of hearty sympathy and accord with the views of the architects, while on the other hand there is every evidence that the architects are getting what they want and that the study and care which have been bestowed upon the perfection of the processes incidental to the manufacture of terra-cotta and brick are thoroughly appreciated by those who have the selection of such materials in their hands. Our readers have doubtless noted and in some points possibly not agreed with the letters we have published editorially from different architects in regard to bricks and terra-cottas, but, while there is always room for honest disbelief, and while every one will welcome new ideas and different uses of the pressed materials, it is none the less true that architects and brick manufacturers to-day are working together to an extent which would hardly have been thought possible ten years ago. Indeed, we doubt if any such harmony could have been brought about except by the spirit of cooperation which we are sure exists between the best of the brick and terra-cotta manufacturers and our more intelligent and successful architects. Brick as a building material for the best structures has come to stay, beyond any doubt; although, for that matter, brick has always been with us, and from remote antiquity there have not been lacking examples of fine, studious, successful employment of burnt clay in connection with buildings of the highest order, so that only by comparison with the immediate past can the present be termed a brick age. It is, perhaps, a fairer summary of existing conditions to say that the intelligent use of brick has found a natural expression more closely akin to what prevailed in the periods to which we are wont to look as being better than our own in artistic qualities. The time may never come when brick will drive out either stone or iron for external uses, but so long as commercial requirements are so exacting no other materials will be able to so completely and satisfactorily answer the purpose as brick and terra-cotta.

THIS statement by no means implies that we have reached the limit in manufactured clay products. There is a vast opportunity for experiment with colored and especially with glazed bricks and terra-cottas. This is a subject which is often harped upon by architectural journals, which is talked of with interest by architects and manufacturers, and which has been sparingly attempted in sporadic cases; but anything like a constant, coherent, and carefully studied out scheme of glazed external decoration not only has yet to be devised for this country, but, we might say, has never been used at any time. We know the old Greeks applied color lavishly to the exteriors of their buildings. There is every evidence that during some of the more recent epochs color has been used in connection with terra-cotta and brick, especially in Portugal and in the countries which have received an art impulse from the Moorish or Saracen dominations. But if we are able in the future to use the glazed products as successfully as we have used the plain colors the possibilities of brick and terra-cotta will be expanded far beyond any limits at present in view. The constant objection in the eyes of artists to terra-cotta and brick lies in the coarseness of the material. This is not an objection which is in any sense fundamental. Surely there is no finer work in the world in the shape of modeling and exquisite detail than in some of the North Italian brick churches and convents, notably at Pavia; and the colored terra-cottas on the Pistoja Hospital or scattered throughout Italy in the churches and convents show that the Della Robbias were abundantly able to use color with terra-cotta. It is then quite reasonable to expect that, once the movement is inaugurated, if we are not handicapped by the first attempts being absolute failures in taste as well as in execution, within a few years we shall see glazed terra-cottas very extensively used in our large cities.

IT has been a matter of regret to many of our manufacturers and constructors that architects and builders have not done more with cohesive constructions analogous to the Guastavino archings. The floors of the Public Library in Boston which are constructed in this manner have proved exceedingly satisfactory as far as can be judged by visible inspection. Nor have the ordinary forms of terra-cotta floor archings received the study they merit, for almost the only change in the shapes was that which introduced the so-called end construction, so that, while artistic as well as commercial exigencies have been almost exclusively concentrated upon external effects, less advance has been made in the terra-cottas intended for floor construction. A recent writer on the subject has said, with a considerable degree of truth, that there is scarcely a material used in constructional work of whose general and specific properties of resistance we have so limited a knowledge as of terra-cotta and tile work; and yet in the modern building the use of such material for floors has become so widely extended that terra-cotta, or porous tile, has become one of the most ordinary materials of construction. Tests of terra-cotta arches have been reported from time to time in the columns of this journal, and some very exhaustive tests have resulted in demonstrating the possible capacities of certain constructions. But there certainly is room for improvement, not so much in theory as in the actual details which the constructor requires for use for archings or for ceilings, and now that the clay palette of the designer, so to speak, has reached such an extended scale it might not be amiss to turn some of our energies to the existing forms of terra-cotta floor construction.

BRICK for floor arches is rarely seen in modern buildings, on account of the greater ease with which the manufactured shapes can be adapted to the seemingly necessary steel construction, but there are some forms of brick vaulting which offer great possibilities. No one can travel through Germany without being impressed with the extent and variety of brick floor construction. What is known as the Welch Vault is hardly ever seen with us, and there are many special kinds of brick construction which can be used in many cases to the utmost advantage in modern buildings, thereby eliminating to a great extent the structural steel work, which of itself is one of the most dangerous elements when attacked by either fire or water, and which owes its strength and endurance chiefly to the terra-cotta or brick envelope by which we surround it. It may never be practicable, even with Guastavino archings, to span such extended areas as we find in Roman work, but anything which tends to diminish the destructible elements in a building and increases the percentage of material which will endure indefinitely is a gain to good construction.

So that, to paraphrase a familiar quotation, the brick and terra-cotta industries may not be what we want them to be, they may not be what they ought to be, nor what we hope them to be, but, thanks to the energy and enterprise of our manufacturers, they are not what they were, and, all things considered, there is no other one department of building enterprise which shows so much activity and such a large degree of intelligent and vigorous growth.

OUR ILLUSTRATED ADVERTISEMENTS.

THE adjoining print and the one on page xxi contained in the advertisements of the New York Architectural Terra-Cotta Company illustrate some of the ornament used on the dry goods store of Siegel, Cooper Company, now in course of erection on 18th and 19th Streets and Sixth Avenue, New York City.

With a total frontage of 1,104 ft., the architects, Messrs. DeLemos and Cordes, have had exceptional opportunities for effective and harmonious treatment; and of these they have availed themselves very fully. In the center of Sixth Avenue front a tower rises to a height of 225 ft. The first story is necessarily of plate glass and iron, as may be guessed; but above this point the predominating features will be cream-white terra-cotta, rich in ornament without yielding to the common temptation (which some architects are unable to resist) of over-elaboration.

The illustration in the advertisement of The Grueby Faiençe Company (see page xx) is of an altar panel by Luca della Robbia from the mortuary of the Prince of Pionbino.

The original is now in the Metropolitan Museum of Art, New York City,— the gift of Henry G. Marquand, Esq.

A most successful reproduction of this panel has been made by the Grueby Company.

TO DRAFTSMEN.

ANY draftsman out of employment, who will send us his full address and answer the following questions: —

By whom were you last employed?
Can you furnish good recommendations from your last employer?
On what particular line of work have you been engaged?
What salary do you expect to receive?
Are you willing to go to another city?

may have his name placed in our Exchange Bureau, and will be notified of any parties desiring his services as a draftsman.

All such communications will be regarded as confidential, and no charge will be made.

Address, EXCHANGE BUREAU,
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TO ARCHITECTS.

WE call your attention to the foregoing announcement, and upon your application would be pleased to put you in communication with any draftsman whom we think would meet your requirements. All communications will be regarded as confidential, and no charge will be made.

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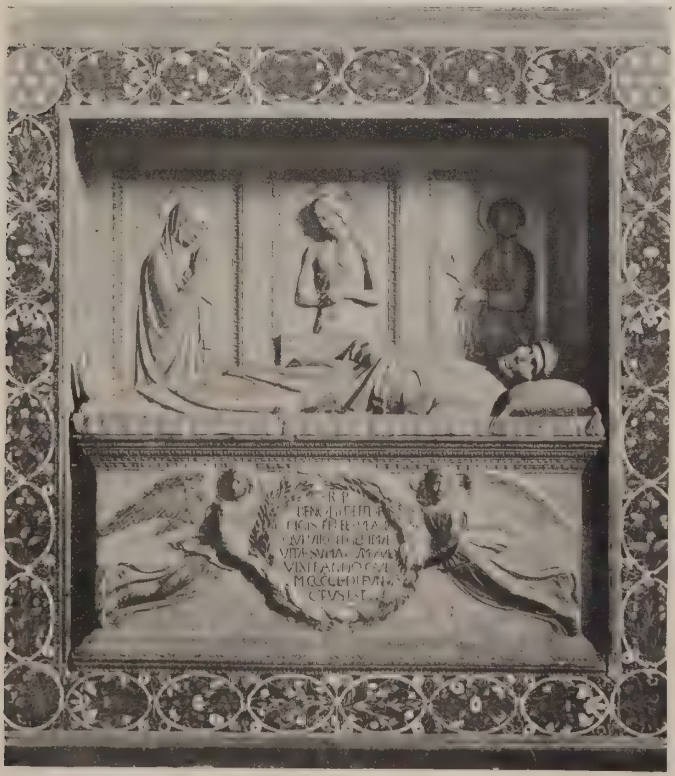
BEGINNING with the January number, the publishing day of THE BRICKBUILDER will be changed from the twenty-fifth to the twentieth day of each month.

LUCA DELLA ROBBIA AND HIS USE OF GLAZED TERRA-COTTA.

BY ALLAN MARQUAND.

THE application of a vitreous glaze for the protection of terra-cotta is of immemorial antiquity. It was used by the early Babylonians and Egyptians, was adopted later by the Persians, and seems to have been introduced as a practical art into Europe chiefly through the agency of the Saracens. It is useless, therefore, to explode the myth which connects the name of Luca della Robbia with its invention. That there was a trade secret in the composition of the glaze used by Luca and that it was lost in the following century is open to doubt, for we find considerable variation in the quality of the glaze used by different members of the Robbia family, as well as abundant instances of glazed sculptures by artists of other schools. Nevertheless, no one will deny that Luca and his school made glazed terra-cotta sculpture popular in Italy during the fifteenth and sixteenth centuries. The secret of this popularity lay in the artistic and representative character of their work, and in the fact that glazed terra-cotta was an effective and cheaper medium than marble or bronze. Hence its extensive use, especially in decoration and in country towns.

The first examples of Luca's work in this material to which a definite date can be assigned are the Resurrection (1443) and Ascension (1446) reliefs over the sacristy doors of the Cathedral of Florence. These were certainly not his earliest efforts in glazed terra-cotta, for the cathedral authorities would not have sacrificed so valuable a space for experiments. The four medallions of Evangelists which decorate the dome of the Pazzi Chapel were, doubtless, put in place soon after 1420, and are ascribed to Luca, although not executed in his style. Luca's Resurrection relief, we may observe, seems to have been inspired by a similar representation upon Ghiberti's earliest Baptistry Gates, and in a medallion of the Nativity, now in the South Kensington Museum, we find a corresponding relation to Ghiberti's style. We cannot be far wrong in assuming, therefore, that in his earliest works Luca exhibited strongly the influence of Ghiberti. Such an influence we see in the tympanum which once stood above the door of the little church of San Pierino in Mercato, now transferred to the National Museum of Florence. There is less of it in the beautiful lunette still in place over what is now a shop in the Via dell' Agnolo. These works are somewhat experimental in character as compared with the Cathedral lunettes, where the glazing is more perfect and the use of various colors beneath the glaze more abundant.



TOMB OF BISHOP BENOZZO FEDERIGHI, CHURCH OF S. FRANCESCO DI PAOLA.

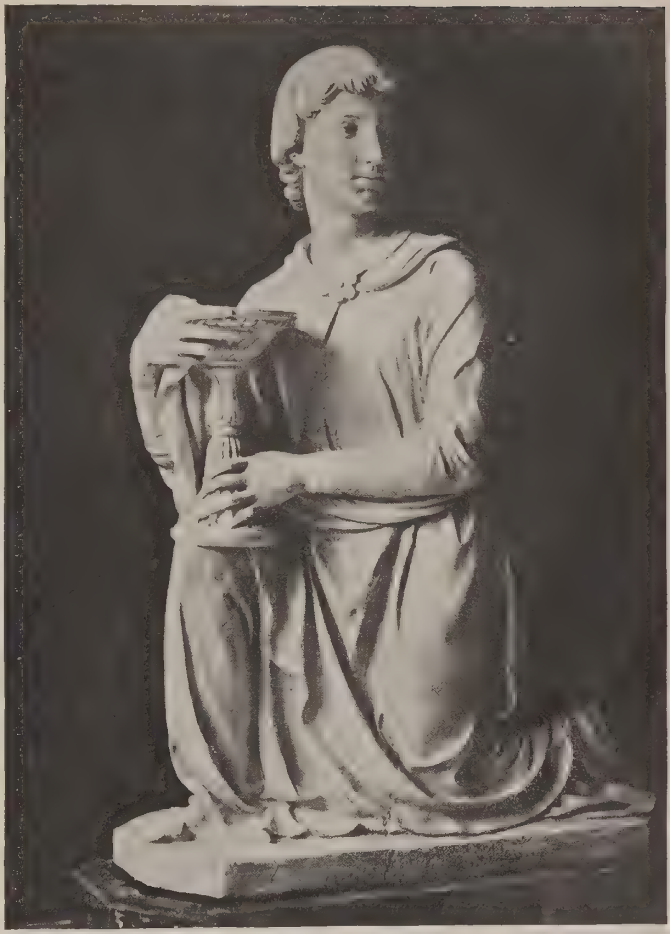
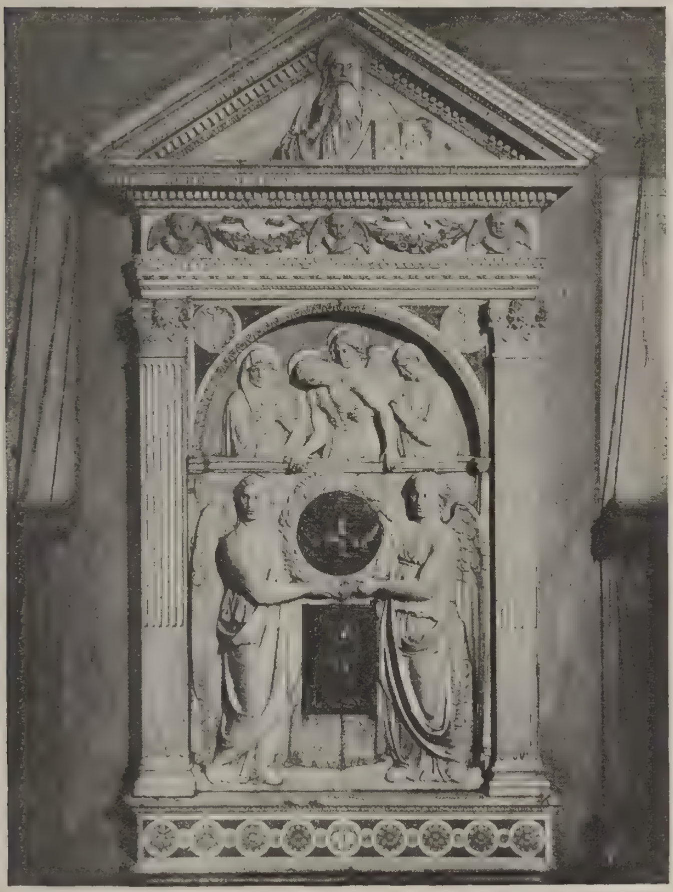


FIGURE OF ANGEL IN THE OLD SACRISTY, FLORENCE.

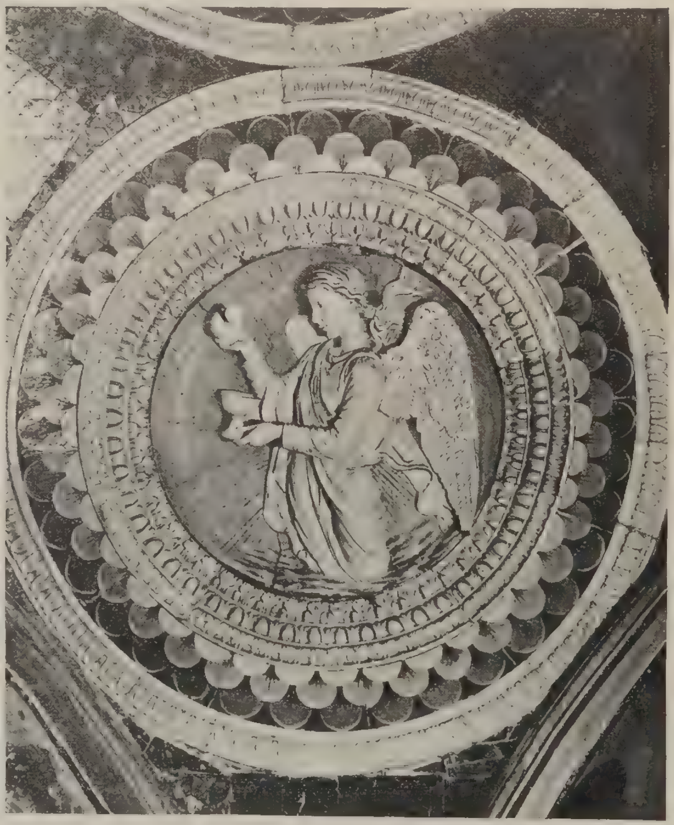
From 1446 onward Luca seems to have been in full possession of polychromatic glazing. The Madonna and Child in a tabernacle on the exterior of Or San Michele may even be earlier than this, and yet the garments, hair, eyes, throne, lilies, and background are variously colored. Even here we may observe a sense for fine shades of color, in which direction Luca surpassed all the members of his school. His nephew Andrea rarely did more than lay in the background in blue, and Andrea's sons exhibited a degenerate sense of color as well as of form. The visitor to Florence will not have far to go to find examples of Luca's skill in color glazing. Besides the Madonna, there are also upon the exterior of Or San Michele other medallions, one facing the Via Calzaioli and representing the arms of the General Council of Merchants, and the other those of the Guild of Stone Masons and Carpenters. Both of these are noteworthy monuments, involving fine design, delicate sculpture, and charming combinations of color. Across the Arno in the little-frequented church of S. Francesco di Paola is found the tomb of Bishop Benozzo Federighi. The marble figure of the sleeping bishop and the Pietà reliefs in the background bear witness to Luca's dignified and reverential and yet thoroughly plastic treatment of sacred themes. But it is the exquisite frame, unique in the history of art, which here calls for our attention. It is a polychromatic glazed terra-cotta frame, exhibiting roses, lilies, and other flowers, not painted and baked in large masses with ugly visible joints, but, like glass mosaics, broken into small irregular pieces uniting to form a complete and solid whole. It is, in fact, a mosaic of glazed terra-cotta units, and worthy of the attention of modern decorators for its method as well as for its beauty, appropriateness, and unconscious charm.

In the marble tabernacle at Sta. Maria in Peretola, besides the use of terra-cotta mosaic in the predella, Luca tries another experiment, that of applying terra-cotta ornament to a marble background. The frieze of cherub heads connected by garlands is polychromatic glazed terra-cotta. This tabernacle happens to be one of those fortunate monuments, the authorship of which is established by external as well as internal evidence. It was made by Luca della Robbia in 1442. With these charming infant faces before us, one cannot help asking whether Vasari can be correct in ascribing to Andrea della Robbia the series of medallions which decorate the porch of the Innocenti Hospital. These infants have passed down to us unchallenged as the handiwork, not of Luca, but of Andrea. But let any one who knows them well ask himself whether Andrea, with all his charm of manner, ever produced anything quite so natural, so varied, and so beautifully colored as these Innocenti infants.


TABERNACLE AT S. MARIA IN PERETOLA.

There is still another process exhibited by Luca in a little known but exquisite monument, six miles from Florence, at Impruneta. This is called the Altar of the Holy Cross, and is in the form of a tabernacle. The pilasters exhibit delicate floral work in raised relief, set against a background alternately red, green, and violet. This harmonious polychromatic background for the white relief is but one of many instances where Luca set himself against monotony of treatment. If we should examine a series of Luca's Madonnas, they would tell us of the spontaneity of his method — no two of them are precisely alike — and of the pains he took with their frameworks of fruit and flowers, which so soon afterwards became conventional and monotonous in the hands of later members of his school. These reveal to us his skill as a sculptor, and as well his boldness as a potter, ready to risk the products of laborious work to the treachery of the furnace. No wonder that his less skilled successors economized their efforts and made greater use of repetition.

I do not recall any tiled pavement which may indubitably be ascribed to the elder Luca. Robbia pavements are not numerous, and are usually to be attributed to later members of the school. There is a very fine example in the Collegiate Church at Empoli, which was probably executed before Luca's death, and may have been inspired by him. In ceiling decoration, he attempted even the difficult task of applying terra-cotta to curved surfaces. Witness the simple but beautiful rotunda in the portico of the Pazzi Chapel at Florence, and the more ambitious medallioned vault of the Portogallo chapel at S. Miniato. In the latter case we begin to see economical methods used to the disadvantage of artistic effect in the background between the medallions. This produces the appearance of a mosaic field of small cubes, but it was executed on rectangular tiles, each of which represents a dozen cubes. The lines of juncture of the tiles are now visible, thus leaving the impression of an imitation of glass mosaic. In the same church Luca aided Michelozzo Michelozzi in giving the charm of polychromy to the marble baldachino above the altar in the western portion of the nave. He decorated its arched vault and roof with polychromatic terra-cotta ornament, and made the terra-cotta frieze, designed from the crest of Pierino de' Medici.


MEDALLION, TEMPERANCE, CHURCH OF S. MINIATO, NEAR FLORENCE.

Luca carried the art of glazed terra-cotta still further into the art of sculpture, fashioning in this material statues in the round. There are two dignified statues of acolytes or boys bearing candelabra in the sacristy of the Cathedral at Florence. There is also at Pistoia in the church of S. Giovanni fuorcivitas a noble group representing the Visitation. Baedeker and Murray repeat the local attribution and assign it to Fra Paolino, an artist known to us only as a painter. Dr. Bode, with greater insight, attributes it in his latest edition of Burchhardt's Cicerone to Andrea della Robbia, and says of it: "Andrea della Robbia's most important work, falsely ascribed to Fra Paolino, is the group of the Visitation in S. Giovanni fuorcivitas in Pistoia, which in nobility of sentiment, beauty of form, and skilfulness of arrangement deserves to be called the most perfect group of the Renaissance." But a careful comparison of this monument with the known works of Luca on the one hand, and of Andrea on the other, shows that the work is more properly to be ascribed to the elder Luca. The reasons for changing the attribution I have given in the *American Journal of Archæology* for January, 1894, and since then Dr. Bode has written me that he is prepared to accept my view. So that this fine group, which has already aroused admiration in this country from the casts of it in the Boston and Norwich museums and which there stand unattributed, may now be recognized as almost certainly the work of Luca della Robbia.

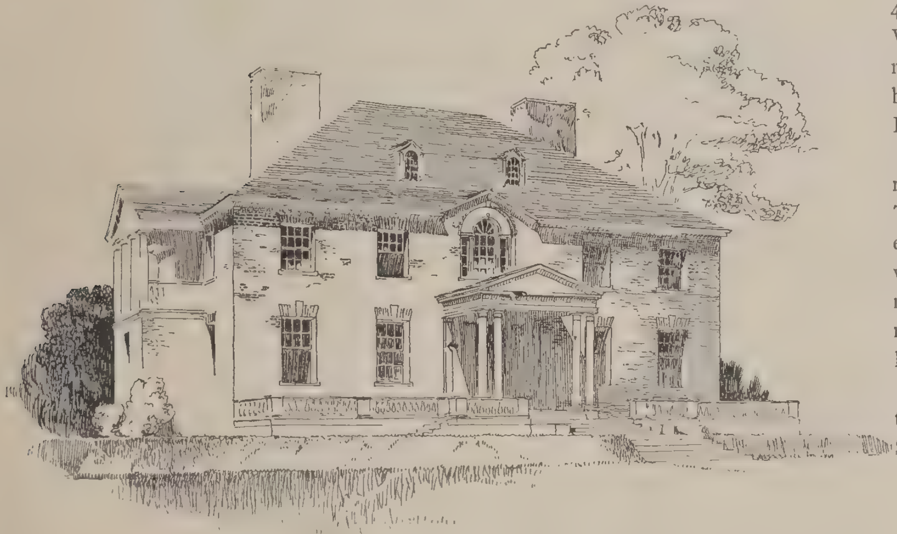
(*To be continued.*)

THE USE OF BRICK IN DOMESTIC ARCHITECTURE.

BY RALPH ADAMS CRAM.

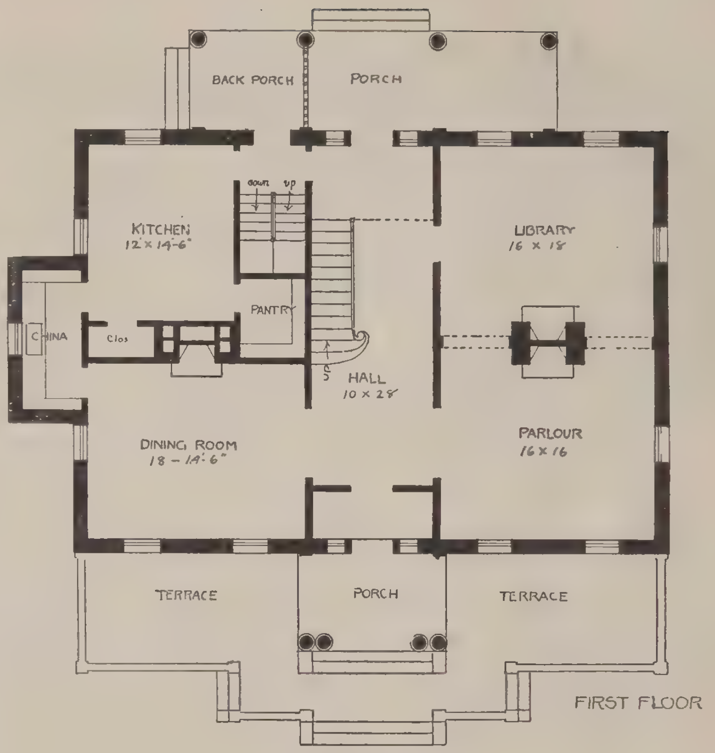
(*Continued.*)

SURPRISING as is the fact that we seldom find brick used intelligently in low cost workmen's cottages, whether in the suburbs of cities or in the country, the abandonment of this material for dwellings of higher cost is even more remarkable. In the former case the slight extra cost must be taken into consideration; but in the class of work I speak of now this is not an important factor. A few hundred dollars added to the cost of an eight or ten thousand dollar house is not a particularly serious item, particularly as this, — the amount of extra expense, — may be almost wholly made up by sacrificing some of the useless ornamentation which is indulged in under the mistaken impression that it adds to the richness of the effect. A little less lavish distribution of quartered oak, fancy cabinet work, papier-mâché, and stained glass, would make possible honest and durable brick construction in place of flimsy clapboards and shingles.



To be sure, we certainly find brick used in a half-hearted sort of way, for the first story, perhaps, or for one gable, or for a large and meaningless outside chimney, but this is not good construction, and it is generally bad art as well, so it has little to commend it. Brick, if used at all, should be used for all the walls, after the fashion of our own old colonial work or the beautiful domestic architecture of some of the English counties.

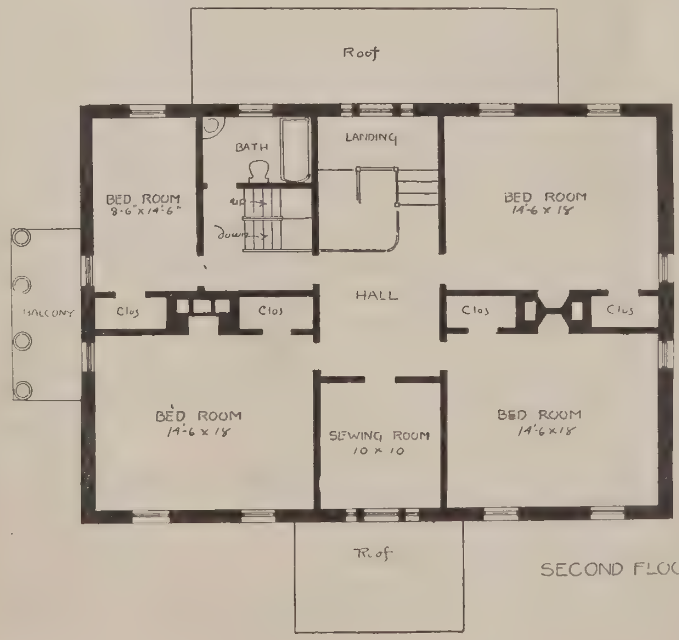
There is plenty of precedent for this. Here in America we have innumerable examples of the use of brick in domestic work, and nothing could be more frank and good than the brick colonial mansions both North and South. In England, half the charm of some sections of the country lies in the brick manors and cottages of the time of Queen Anne. In both instances these works have lasted in good preservation, while wooden structures have gone badly to pieces. Considering that the old examples of this latter mode of construction were built of enormous beams of hewn timber, the question naturally arises, — what would have been their limit of duration had they been built with balloon construction, or of 2 in. x 4 in. spruce joists, sheathed and clapboarded and plastered inside? We shall see the answer to this question pretty soon, when the myriads of ramshackle cottages built during the last twenty years begin to go to pieces. The method followed by the lamented "One Hoss Shay" will be nothing to it.



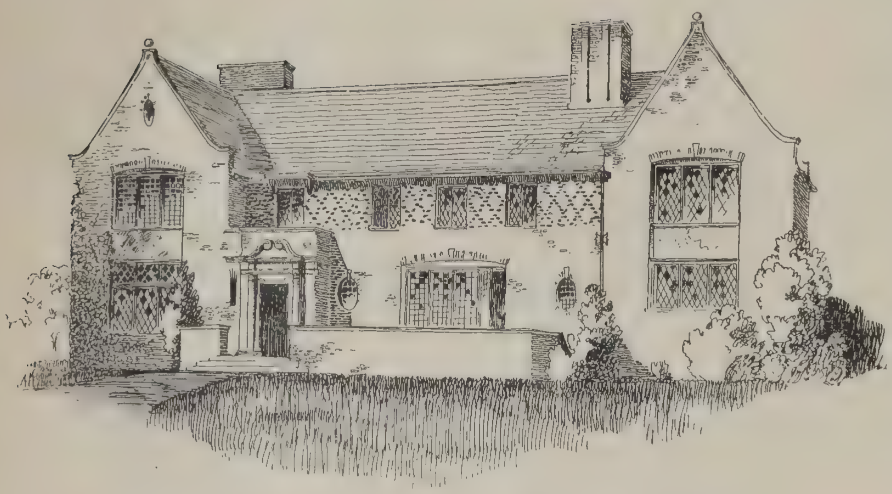
FIRST FLOOR

Why not build permanently, then, and such structures as will, moreover, be delightful to the eye and an addition to the landscape? The extra cost is really hardly worth considering, and the gain is enormous. First of all in the direction of material advantage, for a well-built brick home will last for centuries; it is warm and tight; it needs little repair; no repainting outside except for wooden trimmings or outer shutters; and it resists fire better than a wooden house.

In the second place, it may be made a very beautiful adjunct to the landscape. Few wooden houses, as these are built now, are this. Some of the simple colonial mansions and farmhouses harmonized

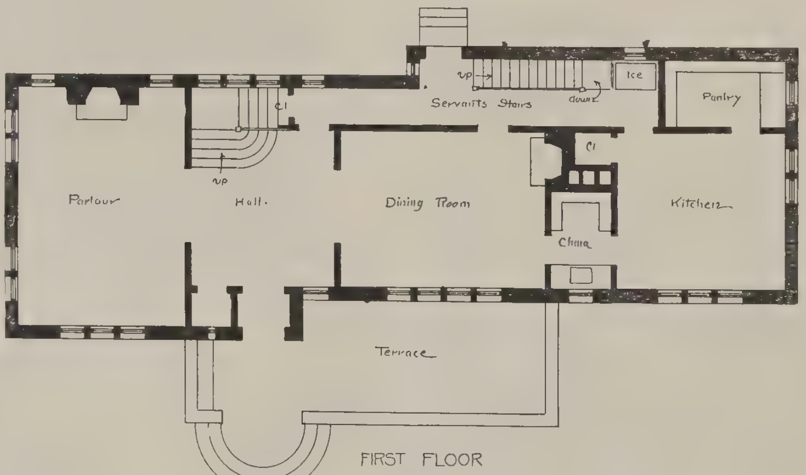


SECOND FLOOR



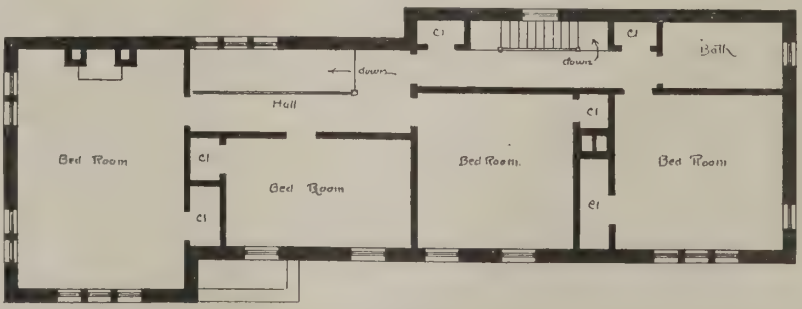
well with their surroundings; but we have pretty nearly lost the knack of building in this fashion, and out of a hundred modern dwellings of moderate cost hardly one fits its place; the others are crazy in their fantastic irregularity, tawdry in color, meaningless in ornament, shapeless in mass, as well as uneasy in plan and affected in internal arrangement. They swear at the landscape, and the landscape hates them for it. By and by it will have its revenge, and the silly little impertinences will crumble into ignoble ruin.

With good brick used intelligently there would be less danger of such a conflict between nature and — artifice. If only the brick is left alone. Here is the same danger that rises rampant in wooden construction, but the chances are less. The trouble with much wooden work is that architects, or, rather, builders, don't stop when they get through. The colonial builders did this, and their work was calm and straightforward, no matter how rude and illiterate from a purist's standpoint. Now, however, the ordinary builder musses his plan and his design up shamefully, and the poor house that is the result of its author's striving after effect is always ashamed of itself, and it shows it.



FIRST FLOOR

Brick is a less tractable material than wood, and so in its use the chances of chaos are lessened. Leave it alone and it will come out all right, but try to twist it into the popular forms and it will fit them about as well as Latin will fit a dime museum song and dance. If fantastic bay windows, towers, gables, dormers, turrets, and porches are desired, then brick is out of the question, for if it were used the above-named elegant accessories would probably be built of a galvanized iron or copper, and this is a crime, or, rather, a vice. Still, the said accessories are shocking in any case, so they need hardly be considered.



SECOND FLOOR.

If, however, we can be content to admit that we know very little about the artistic side of house building, and that our ancestors knew a good deal, and so go back to their methods, we can use brick as well as they did, and with as good results. In order to do this, we must, however, give up that system of planning which is exemplified by the crazy quilt, and go back to something simpler. The old square four-roomed colonial house, with its great hall in the middle, and its big-hipped roof and huge chimney-stacks, was about as good as any plan ever devised, and it has an innumerable number of variants, so it never need be commonplace. Built of brick, it is a thing of beauty and dignity; witness the noble old piles in Salem and Portsmouth, and in Maryland and Virginia. With every year the color of the bricks improves, while with every year the color of a wooden house — if it is painted often enough — gets worse and worse.

How beautifully these old brick mansions rise out of green lawns and among thick trees, with their delicate white trimmings and gray roofs, and solid chimneys. From every brick exudes an aroma of dignity, and reserve, and good breeding. Now and then, in Newburyport, for example, you will see a pert and prancing minx of a "modern colonial" or "Queen Anne" house, crowded up against one of these monuments of an old regime, and the contrast is instructive of all the difference between then and now, between a house with some self-respect and one that is simply brazen.

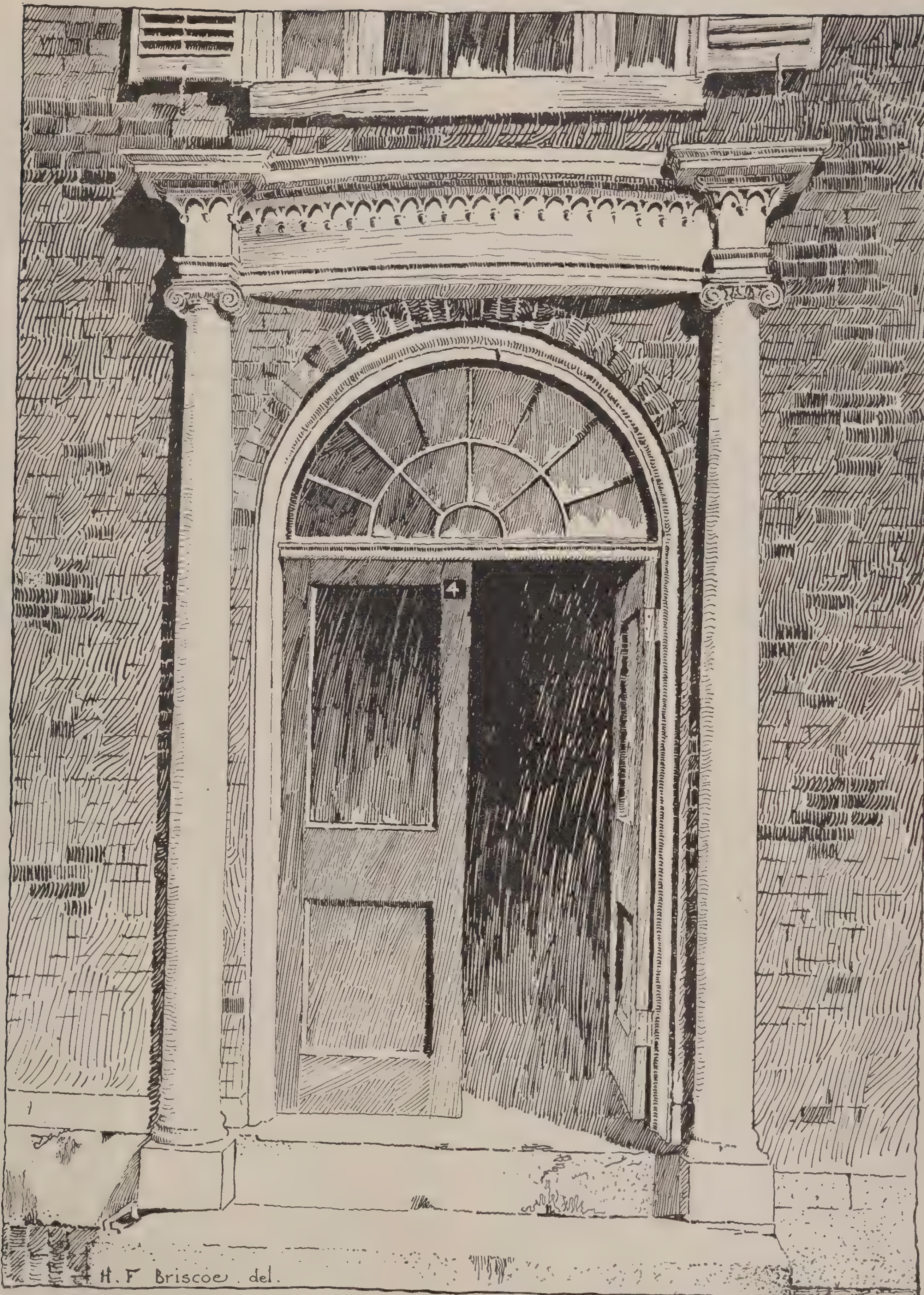
It may be that the modern "tasty house" represents the culture of the time, and that the brick mansion does not. If this is absolutely so, then it is of no use for us to try to build as our great-grandfathers did, but until we are sure that there is no health in us let us assume that there is something in our contemporary life that is not best expressed by party-colored paint, galvanized iron bay windows, and crazy roofs, and so build a little more as our ancestors built before us.

The two accompanying sketches are only rough suggestions of the use of brick in houses to cost eight or ten thousand dollars. Thousands of dwellings of this cost are built every year, but their tawdriness is a proverb. If we stuck more closely by precedent, the result would certainly be less lamentable.

One of these designs is worked out on typical colonial lines, — square, formal, and regular. Of course it is red brick outside, and its trimmings are of wood painted white. The other design is, in plan and exterior treatment, modeled somewhat on Queen Anne work in England. It also should be of red or gray brick, with a simpler diaper ornament in black headers. Here, also, the trimmings are of wood painted white.

Either of these houses could be built for eight or ten thousand dollars, and that either would last longer and fit the landscape better than much of the nonsense that is sprouting out of the earth around every city in the country is proved by the originals on which both are modeled.

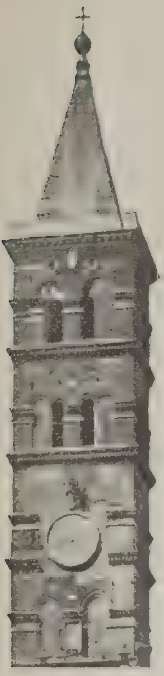
THE City House Competition Drawings will be at the annual exhibition of the Pennsylvania Academy of the Fine Arts, which opens in Philadelphia this month.



DOORWAY "TUFTS HOUSE," PORTSMOUTH, N. H.

ITALIAN TOWERS — ROME.

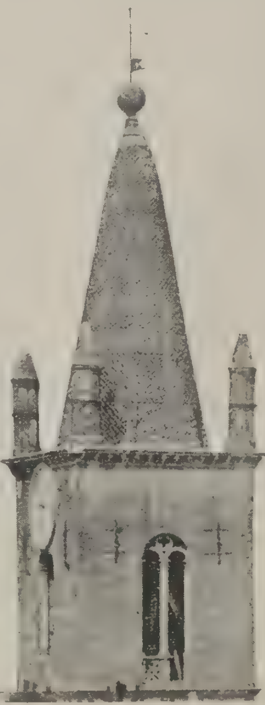
BY C. HOWARD WALKER.



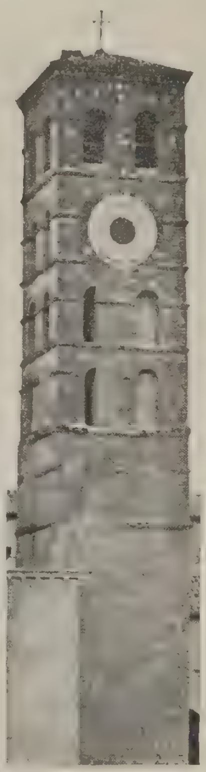
SANTA MARIA MAGGIORE.

IN the churches of Italy the campanile or bell-tower is a prominent and characteristic feature. Originally a merely utilitarian adjunct of the church — built in most cases centuries after the founding and completion of the building to which it was attached — it became the parent of the great towers of the Gothic Cathedral and introduced a new and most interesting factor into architecture. It is rare that a church is now erected without a tower or spire. The use of such tower as an elevation from which the bells calling to service can be rung and heard afar is not only forgotten, but in many cases the sound of the bells themselves is considered objectionable; the tower has ceased to be a bell-tower, but is a distinctive symbol of the dedication of the building to religious uses. Civic towers arise for the same purpose, in regard to the use of bells, in the Italian communes, as the great towers of the town halls of Florence, Sienna, Volterra, testify.

After the Christian religion became established in the reign of Constantine, and the basilican churches of Rome became the type of the early Christian church, the call to service was given by blows upon a sonorous piece of wood by a mallet or staff. In the monasteries of the Greek Islands this custom still exists, and the midnight services are announced by rapping upon a long board hung between two columns in the cloisters, despite the fact that there is a belfry to the monastery church and a bell to call the peasants from the neighboring villages to the day services. Undoubtedly the substitution of metal for wood was made very early in the history of the church, and the bell, the campana, became the call for assembling the people, either for religious service, for the announcement of news, or for cooperation against danger, etc. That this bell should be elevated, so that its sound should be unmuffled and should be heard at a distance, is an obvious necessity, and the first towers or campanile are merely tall buildings with a square plan, with sufficient space inside for a staircase only, and with the bell story with larger openings than any of the stories below, these latter merely requiring enough openings to light the stairs, while the bell story required as much opening as possible to permit the sound of the bell to be heard. As there was no necessity for stories above the bell deck, the purpose of the tower being accomplished at that point, the campanile became a well-established type of tower, with solid walls and small openings, until the top was reached, when the openings became large and the wall spaces slight. Like most organic schemes in architecture, the mere logic of the conditions produced a very beautiful form. By far the larger proportion of the Roman campanile — and, as Rome was the seat of the head of the church, the earliest examples of Italian towers are to be sought for within her walls and are attached to basilicas and monasteries which were built in the sixth, seventh, eighth, ninth, and tenth centuries. The campanile themselves, however, when their date can be established, are ascribed to the twelfth, thirteenth, and early part of the fourteenth centuries. What actually occurs is this,— that the Roman medieval campanile is a well-developed type in the ninth century, as the campanile of Santa Pudenziana shows, but that for the next one hundred and fifty years Rome was so torn with internal dissensions, wars between opposing nobles, that the architects devote the most of their time to building fortress palaces and the towers on the city walls. In 1257 Brancaleone destroyed one hundred and forty of these citadels and strongholds in Rome alone, and, as a result of the comparative peace of the following decades, a great number of campanile are erected near the churches. They revert, however, to the earlier type, and, although in the interval Gothic architecture has developed in the north, the towers of Rome maintain their round arches, arcaded groups of openings, and delicate classic cornices of the eighth and ninth centuries.



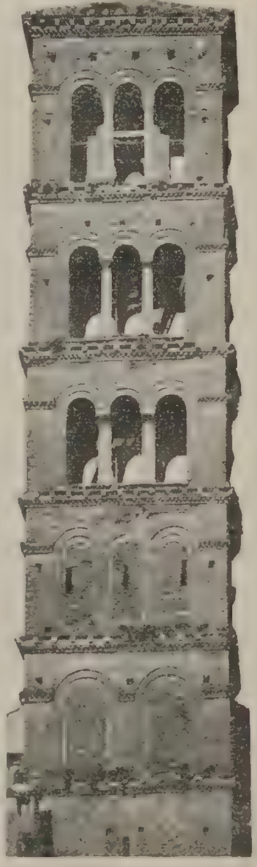
S. MARIA DEL POPOLO.



S. LORENZO, IN LUCINA.

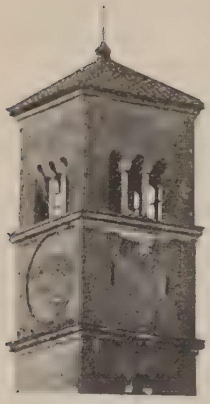
All the earlier buildings of the medieval time used the numberless fragments of classic moldings, cornices, brackets, and capitals indiscriminately. One has only to glance at the entablatures above the columns in San Lorenzo, *fuori le mure*, or, indeed, at the very columns themselves, to recognize the fact that medieval architecture had appropriated most of its ornamented motives, at least, from Roman buildings. These fragments are coarsely put together, and there is every indication of the absolute lack of knowledge of stone cutting in the early medieval times.

The marbles which covered the brickwork of the Roman buildings, however, supplied excellent lime at the mere cost of the burning, and the buildings themselves with walls 18 and 20 ft. thick were veritable brick quarries. The early Christian church was acknowledgedly poor. It had, however, all the materials for building free at its disposal; the labor of putting together these materials was alone required. That labor was of the crudest description. The brick, taken from the ruins of a neighboring Roman building, was laid roughly with huge joints filled with lime made of the marble found amidst the ruins; whenever an ornamental molding was found in sufficient quantity it was used as a sill-course to the openings. If it was long enough it was made a belt-course around the tower. Sculptured ornament was in most cases too battered for use, but numerous modillions were always to be found. These were placed at regular intervals to support the string-courses. If they were lacking, brick corbels took their places. The small columns were cut but had no entasis, the capitals were of the simplest description. Here there is an architectural type, — a tower of brick with white marble string-course at each story, with corbels of marble or of brick supporting the string-courses, with small openings in the lower part of the tower, and larger ones at times as the tower ascends, but always with the largest openings at the

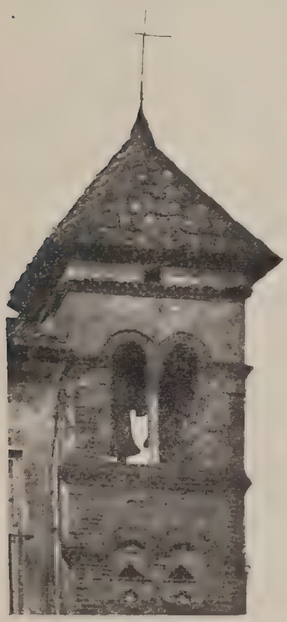


SANTA PUDENZIANA.

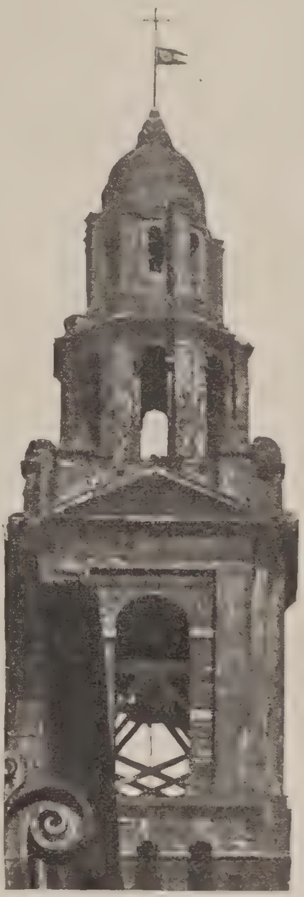
top, with roof very nearly flat until the early part of the fourteenth century, when, under Urban V. and Gregory XI., pointed roofs are put upon several of the towers. The beauty of these towers is produced by their slenderness and the proportions of their successive stories to each other and of the openings to the walls, and, as is apt to be the case, the simplest disposition of the belt-courses and of the openings has produced the best results. The heights of the successive stories are usually alike until the bell deck is reached.


S. SABINA, IN THE AVENTINE.

The belt-courses vary but little. The upper story is treated individually. Nothing can be simpler than these towers; yet they have a very individual beauty, and are as good types of brick towers as are to be found. The later towers often have their walls strengthened by piers and arches; but the earlier ones are with plain brick walls. The illustrations show the best examples of the Roman towers, and the following notes indicate the history of the churches to which they belong.

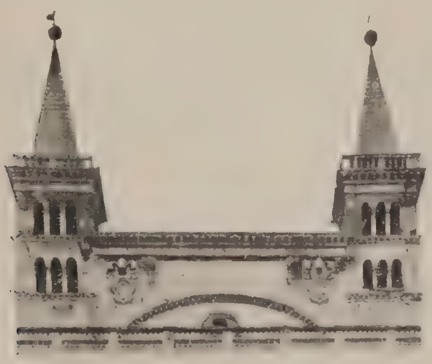

SAN BENEDICT, IN TRANSTEVERE.

Santa Maria del Popolo, in the Piazza del Popolo at Rome. The church was erected by Pope Paschalis II., in 1099, and was re-erected by Sextus IV. in 1477–80. The tower, which is small, resembles a tower in Mantua, and, from having a pointed roof, is subsequent to 1330. This tower has marked Gothic character.


SANTA MARIA, IN COMARO.

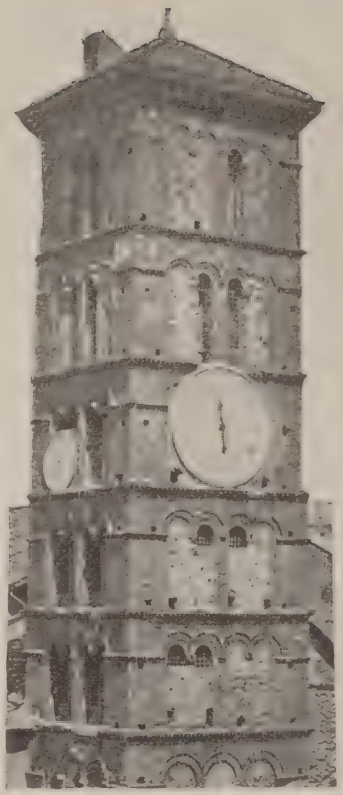
Santa Pudenziane, reputed to be the oldest church in Rome, was restored as early as 384 A. D. by Pope Sericius. The tower is ascribed to the ninth century.

Santa Maria Maggiore, one of the finest of the Roman towers. The church is the largest of the eighty churches in Rome and was one of the five patriarchal churches. The basilica was built 352 and re-erected 432. In the twelfth century the church was altered, and the tower belongs to this period. Gregory XI., 1370, gave the tower its present form and pointed roof.


GIOVANNI, LATERANO.

San Lorenzo, in Lucina, founded in fourth century; tower probably of ninth century.

San Silvestro, in Capite, built by Paul I., 757–67; tower probably of ninth century.


S. SILVESTRO.

San Giovanni, in Laterano, south transept. Church built in sixth century, overthrown by earthquake 896, destroyed by fire in 1308 and again in 1360. Rebuilt by Urban V. and Gregory XI., when the present small campanile were erected. The caps to these were added by Pius IV., 1559.

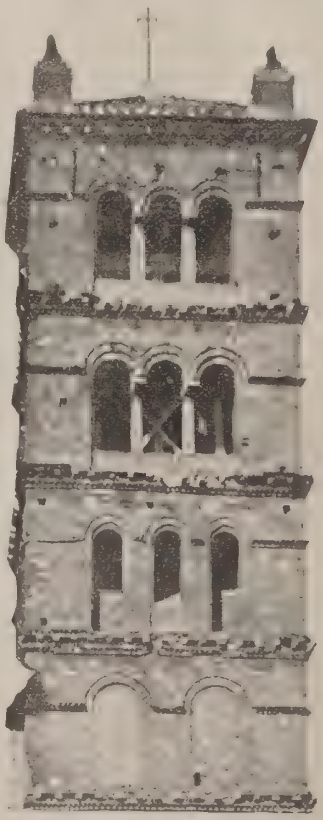
Santa Cecilia, in Transtevere, reputed built by Urban I., 230 A. D., restored by Paschalis I., 817 A. D.; tower probably ninth century.

(To be continued.)

CLUB NOTES.

On the night of December 17 the Chicago Architectural Club took up the study of the Lake Front Park at the class meeting. Christmas was celebrated on the night of the 23d, the features of the evening being a Christmas tree which Santa Claus had hung heavy with presents for the members. The hosts for the evening were Arthur Heun, Fritz Wagner, W. B. Mundie, W. G. Williamsen, Hugh M. G. Garden, Edgar S. Belden. Other interesting events for the month have been an exhibition of lantern slide views of historic buildings in Rome, on the evening of December 2.

The Regular Bohemian Night was held at the club rooms, Monday evening, December 9. Hosts: Mr. W. W. Vernon, Dr. J. E. Colburn, C. S. A., Mr. M. H. Hunt, Mr. C. E. Birge, C. A. C.


S. CECILIA, IN TRANSTEVERE.

THE first annual exhibition of the Cleveland Architectural Club will open February 10. Applications for space should be made not later than January 20.

Fire-proofing Department.

Conducted in the Interest of Building Construction to Prevent Loss by Fire.

THE FIRE-PROOFING OF BUILDINGS AND IMPROVEMENT IN ARCHITECTURAL METHODS.

BY HOWARD CONSTABLE.

MEMBER OF AMERICAN INSTITUTE OF ARCHITECTS, N. Y. CHAPTER.
AMERICAN SOCIETY OF CIVIL ENGINEERS.

THERE has been much surprise and disappointment expressed about "fire-proof buildings" because loss and damage has occurred to some of them in recent fires. As a matter of fact, it will be found that those buildings are only so-called fire-proof buildings, and are not altogether constructed on the best principles to resist fire; also, that some of the surprise arises from the fact that owners and the public are under the impression or have been misled into the belief that a building can be made entirely safe or absolutely indestructible against any conflagation whatsoever, and that a little fire-proofing scattered throughout a building is sufficient.

It must be remembered that every material has its limit of resistance to heat, and that if it is subjected to a very intense heat because of a great quantity of very combustible contents, or subjected to a very fierce surrounding fire from adjoining buildings of a very inflammable nature, then the construction of the building and the fire-proofing materials must be very carefully considered and selected, and special provision made for extra hazardous contents and surrounding buildings.

It cannot be successfully denied that a great deal of good has been accomplished by fire-proofing, while admitting that there is much room for improvement in the general practise of the art. The very results of the Broadway and Bleeker Street fires are proofs that even partial fire-proofing amounts to a great deal. The "Keep Building" was an absolute and complete wreck, while the "Manhattan Building" was only about one third damaged. This latter building was not a completely fire-proofed structure; the only terra-cotta fire-proofing used was for the ceilings, above which were open spaces or flues 10 ins. by 36 ins., between the beams leaving the iron beams naked on both sides and covered on top with a thin plank under-floor, then a layer of paper, then a ⅞ in. top floor of pine. The girder spans were very long, and expansion and contraction in the girders, beams, and columns not well provided for. The iron roof beams were all exposed and subjected to a very great heat from the large amount of cloth, etc., stored in the top floor; they softened under this heat and sagged over 9 ins., and in the middle portion of the roof pulled away from their supports and crashed through two floors below (the tank going with them). Had these roof beams been thoroughly surrounded with porous terra-cotta, brick, or fire-clay, there would not have been a collapse of any portion of the roof. There was much woodwork in the windows exposed to the adjoining fire, and there was an unnecessary amount of wood in the partitions, and no fire-proofing blocks of brick or terra-cotta. Therefore, it is plain that the building is not a good example of fire-proof construction, and we see why people are naturally surprised at results when a building such as this gets the name of being an absolutely fire-proof structure.

Most of the so-called fire-proof buildings have some very serious defects or omissions in their make-up and do not represent the best that can be done. This arises from the fact that very few men have made any very comprehensive and accurate tests and investigations into the whole subject of fire-proofing materials and methods, and most have relied greatly upon the beliefs and statements of patentees or promoters of some one material or process (which was often in the experimental stage and advocated as suitable for every purpose and place). But where men have been trained to investigate, and experiment, and to base calculations and opinions upon ascertained facts, this ignorance, and neglect, and misapprehension of possible results does not exist. We have sufficient available fire-proofing materials and methods to produce much better results than the average so far attained.

We have fire-brick, terra-cotta, porous terra-cotta, common brick, smelting furnace brick, plumbago and crucible clay, cements and plasters, uninflammable wood process, slow-burning wood construction, asbestos, mineral wool, etc., and the sandstones, slates, blue stones, soapstones, etc., each with a different capacity to resist heat and disintegration and differing in suitability to the various parts of a building and particular exposure to heat and water. We know that we find the greatest resistance to fire in the bricks and terra-cottas, but some tendency to brittleness. We know the great toughness and strength of iron, steel, and other metals, but also their great tendency to warp, twist, and to expand and contract rapidly at comparatively low temperatures. We find great resistance to ultimate destruction in slow-burning wood construction; but the timbers must be large, and the cost of restoring the work to a presentable condition is often very great. We have the cements and plasters lending themselves to ease of application or beauty of appearance, and the marbles and granites, but very liable to disintegration upon the application of heat and water, and so on throughout the list. We know that wood can be rendered non-inflammable — that is, so as to only char slowly under intense heat and not allow flame to spread.

We know that all iron work throughout a building should be completely covered and protected with terra-cotta, porous terra-cotta, or brick; that concealed air spaces forming channels of fire communication are dangerous; that the improvement in electric lighting and in ventilation makes it possible to reduce the window and glass openings; that ornamental terra-cotta mullions and jambs with cast-iron or treated wood window frames will reduce the risk of fire being communicated from adjoining buildings; that special provision should be made for very inflammable contents and extra hazardous surrounding, and that many of the defects and omissions so common in the ordinary "fire-proof building" can be avoided and are not so expensive as many suppose.

We know within limits the softening and melting points of most of the materials, and have arrived at the proper basis and line of direction in which to experiment, and the experience upon which we should base our work in order to secure practical results and make fire-proofing a more extensively used and more practical art and science. It merely needs accurate, practical, and scientific knowledge of the resistance and strength of materials, improved methods of construction, and experience and judgment in applying this knowledge, cooperating together with the artistic understanding whereby we should "ornament our construction and not construct our ornament," as Ruskin claims, in order to produce substantial fire-proof buildings, at reasonable prices, of attractive appearance.

This brings us to taking briefly a broad view of the future progress and improvement to be made in the designing and constructing of modern buildings. It cannot be questioned that the building of a great man-of-war, or ocean greyhound, or of a great bridge, is a far more intricate, elaborate, and expensive undertaking than that of a large office, store, or warehouse building. We can even add to the list that of the locomotive. They can be ordered, designed, and produced with much more facility, accuracy, and certainty as to results and cost than most buildings. And what is the reason? Simply this: That but few owners, architects, or builders have kept fully abreast of the possibilities in their own line, and of the exertions and accomplishments in other fields of modern thought and progress, taking example therefrom and cooperating in a thorough system of procedure in the building and fire-proofing arts.

A few examples will suffice to show how crude and extravagant, even absurd, some of the operations have been.

There is the Manhattan Savings Bank Building, with three or four of the most important conditions of fire-proofing neglected. There is the Ireland Building operation, rotten and stupid from the bottom upwards — common sense and figures ignored and no one knowing or else forgetting that if you reduce a bearing member one half in thickness you decrease its bending strength four times, not twice.

Another recent case is where the building has as much more material in its foundations as the Ireland Building had too little; yet they are cracked because of the same neglect of a practical knowledge of strains and transmission of pressures in materials. In another case of a large dry goods building the upper part looked perfect and was good for 125 to 150 lbs. of goods per square foot of floor surface; when I unearthed the foundations they were not big enough for over 75 lbs. per square foot, so the owner had paid a "practical" builder and "picturesque architect" a good deal for redundancy of body on very weak feet. In the case of old style floors we have them with ten to fifteen per cent. more material and workmanship than the slow-burning mill construction and vastly more combustible; yet the average builder in New York makes them out to cost more. They don't cost more in New England and some other places.

In another case, — a great edifice carrying $2,000,000 worth of goods,— the iron columns and the lower flanges of all the wrought iron floor beams are left exposed, while brick and terra-cotta are most substantially and judiciously used throughout all other parts. We have the case of some gifted surveyors and investigators into the strength of floors reporting the iron columns of a building as having 1 in. thickness of metal and the foundations 5 ft. square, much to the injury of the owners' interest, as it was proved that the columns had 1½ ins. metal, and the foundations were 7 ft. square.

I have recently shown that the factor of safety of floors, walls, etc., sometimes vary from only one half up to twenty times; therefore, the owner is running the risk of an accident in one place and paying for an immense amount of extra material and causing extra size and weight in many other parts of the building, and, consequently, a greater total cost. The factors of safety in a good bridge may be said to vary from three to ten, according to the kind of strain and risk of exposure of the part. Hundreds of buildings change hands with less thorough examination and scrutiny than one gives to a bond for a $1,000 or a $500 horse.

The owner too often looks upon and selects an architect as a maker of pictures and drawings to help him and the practical builder out in that line, not as a trained investigator, compiler, and advisor, one capable of being general manager and arbitrator of the whole department of design, construction, and contracts. The owner or committee often assumes part of this department without special training and technical knowledge, forgetting that they would not do the same in railroad, bridge, or vessel work, but rather keep the finance and physical departments under separate experienced heads with power to decide and act.

The architects and owners too frequently forget that they must first thoroughly understand each other and have a good business and legal method of procedure; that suggestions or conceptions that do not work in harmoniously with the general scheme must be eliminated; that all the conditions of the entire problem should be before them before the design and methods to be used can be crystallized into a consistent practical combination for satisfactory and economical results; otherwise, it is like designing a vessel without the number of the crew or style of engines being given, or a bridge without the weight of the locomotives and their wheel base on track being known, or trying to make a Greek building out of a Queen Anne idea, or a good building with the heating, fire-proofing, and other means of comfort and safety only considered after work is started.

Again, it is too often the practise of the architects to rely on the contractors or sub-contractors for the calculations and the design of details, with no thorough system of checking them up, and to forget that cost and mathematics applied to materials belong to the proper and best practise of architecture, especially in modern work and the conditions of our day and generation.

As regards the builder and owner, it is only too frequent that they over-estimate or really under-estimate the idea of being "practical," to the exclusion of any accurate knowledge of the strains and pressures in a building, the ignoring of calculation and the strength of materials, and the success of improved methods of working and handling materials here and abroad; all of which means that we must, and, in fact, are being forced to see and admit that the engineering faculty and the practical science that has produced the wonderful and beautiful results in steam vessels, bridges, and railroads, etc., must be given a coordinate position to the artistic in the make-up of the true architect, and that its virtue and value must be comprehended more by the practical builder.

In this connection of architecture and engineering it is to be remembered that Michael Angelo, Leonardo Di Vinci, Sir Christopher Wren, and Violet Le Duc showed the highest order of engineering skill, and that many of the greatest painters show the most minute knowledge of the muscle and nerve systems without detriment to their artistic feeling and the beauty of their work. I would also call attention to the fact that in the true and practical application of mathematics and exact science to materials, whereby any construction is well proportioned for its purpose, with its strength of materials and factors of safety properly distributed, it is not necessarily antagonistic to or conflicting with good art. A great battleship, the liner *New York*, the Brooklyn and Washington Bridges, the Locomotive 999, on the New York Central, the Pyramids, and the Parthenon, are examples of a close approach to this principle, and of which must always be said that they are either beautiful, magnificent, or impressive, and stimulating to the imagination.

It is already being appreciated that great aid in making it easier and cheaper to build good buildings can be given us by the improvement and modification of our building laws, whereby the principal kind of buildings can be built under safe and proper rules and regulations appropriate to their particular requirements. The last theater law is a fair illustration. The present law is a slow growth, starting from the last generation, when there were few available materials and only the methods of construction of laying one stone or brick upon another for a foundation and pinning or nailing one piece of wood to an adjoining one, and considering a four or five story building on a 25 ft. lot as the unit or basis for everything. The results have been great inconsistencies, and modifications and endless controversies, in order to suit modern conditions and necessities, and serious expense and obstructions to those who wished to make improvements.

It is now admitted that the most important walls and foundations are not simply masonry work, but combinations of iron and masonry not to be attended to solely by a mason.

The fundamental reason for our Building Department is that of public safety and record, — a department not to design buildings and instruct the ignorant, but to prevent dangerous and detrimental work, and to encourage strong, fire-proof, healthful building and the general commercial and residence welfare and growth of New York. It is to aid in preventing the immense loss of life and property by fire and collapse of buildings, and to ward off a great conflagration like that of Chicago and Boston — to prevent the growth of pest holes and the permanent lodgment of contagious diseases, in order to reduce the great death rate and to ward off great epidemics. And it will be found that the development and application of the best fire-proofing construction will be the most important element in bringing about the much-to-be-desired results, also that the cost of fire-proofing has been steadily reduced so as to be within reach of those who should use it.

Mortars and Concrete Department.

Devoted to Advanced Methods of using Cements and Limes in Building Construction.

AMERICAN CEMENT.

BY URIAH CUMMINGS.

CHAPTER VI. (*Continued.*)

THE CHEMISTRY OF CEMENTS.

THE theory that more than 3 per cent. of magnesia is harmful in an artificial cement has not been sustained, except by the single argument that it remains free or uncombined in the cement, and, owing to the high temperature to which that cement is subjected during calcination, slowly hydrates, and expands after the lapse of many days and, perhaps, months.

Whenever it can be shown that magnesia does not combine with the silica, then the truth of the theory will have to be admitted.

But to establish the theory as a fact it must first be shown that silica and magnesia do not combine, as in serpentine ($Mg_3\ Si_2\ O_7 + {}_2\ H_2O$), Talc ($Si_5\ O_{14}\ Mg_4$), Sepiolite ($Si_3\ O_8\ Mg_2 + {}_2\ H_2\ O$), or in Olivine ($Mg_2\ Si\ O_4$), and among the silicates of magnesia and lime, as in asbestos, the augites, hornblendes, and pyroxene.

How can these be admitted as chemical combinations of silica, lime, and magnesia, without admitting a similar combination in cements?

The theory has not the slightest foundation, in fact. Its absurdity has been demonstrated daily since the foundation of the cement industry in this country.

But in an endeavor to account for the expansion of some of the artificial cements, this theory has been advanced by many leading authorities, principally in Germany, who, it may be noted, have never advertised for an adverse opinion, and among the imitators of those authorities in this country the theory has passed current as sound doctrine. But the untenableness of this doctrine seems not to have occurred to its advocates, even when they find checking and expansion taking place among artificial cements containing but a trace of magnesia.

When a cement containing an excess of lime has been calcined at an extreme high temperature, the free lime will be much slower to hydrate than would be the case were the cement calcined at a lower temperature, and herein may be found the reason for checking, which, to account for, has been attributed to the presence of magnesia.

As instances of this character, the foundation of the Bartholdi statue in New York Harbor may be cited. After this work had been laid several months, the surface became covered with innumerable checks and cracks.

The landing of the main entrance of the Capitol Building, Washington, D. C., fronting Pennsylvania Avenue, was so literally covered with checks and cracks that a dime dropped upon it would rest on a check or crack, and it was found necessary to cover it with asphalt.

Both of the cases cited were done with a German Portland cement having a reputation second to none in this country, and the analysis of which shows but a trace of magnesia.

The only conclusion, therefore, to be drawn is that the checking resulted from a lack of thorough hydration of the lime that was present in excess of true combining proportions.

Had American rock cement been used in the work cited, and had the same results followed, it is extremely probable that the engineer and contractor would have been censured for not having used Portland cement.

The question of hydration is one which demands careful consideration. It is a question which rarely enters into the calculations of engineers and architects, who rely almost wholly on short time tensile tests, which rarely extend beyond thirty days.

A cement which needs hydration will, when this operation is but partially effected, test higher during the time mentioned than when thoroughly hydrated. Yet at the end of six months or a year the benefits of thorough hydration will appear in the tests.

These results follow, whether the cement contains more or less magnesia, not in excess of its true combining proportions.

The author has had a practical experience of many years with the cement which is represented in the table of analyses as No. 29, by which it may be seen that it contains a large percentage of magnesia.

The rock from which this cement is produced, when calcined, at the temperature employed in Portland cement making, *i.e.*, sintered, then ground and hydrated, will weigh, without compacting, 85 lbs. per cube foot, which is equivalent to 106 lbs. per struck bushel.

It will test 100 lbs. tensile strain per square inch at one day, 250 lbs. at seven days, 400 lbs. at one month, 700 lbs. at six months, and at one year a major portion of the briquettes cannot be broken on a 1,000 lb. testing machine.

Commencing in 1883, and continued yearly since that time until the present, briquettes made from this material have been placed in running water, and kept there, and they neither expand, check, nor shrink, but are infinitely harder than the rock from which they were produced.

The motive for presenting this particular instance is because of its direct bearing on the question of the presence and influence of magnesia in a cement.

Practical experiences of this kind completely dispose of many of the fallacies by which the consideration of this subject is complicated.

If the tendency to expand is greater in magnesia than in lime, it ought to exhibit such tendency in the common building lime. Of the more than sixty millions of barrels of this material which is produced yearly in this country, not less than two thirds of it is produced from magnesian limestone, the proportion of magnesia ranging from 10 per cent. up to a percentage rendering the material dolomitic in character.

The heat required for the calcination of this rock is fully as high as that used in the production of Portland cement.

It is generally used immediately after slaking. Yet it does not expand and rupture brickwork and stone masonry, although the magnesia is absolutely free. It is not chemically combined with the lime; neither does it so combine subsequently with the gangue with which it is made into mortar or concrete, its deportment being the same as that of the lime with which it is associated.

If magnesia does not expand in work where it is beyond all question in a free or uncombined condition, it certainly cannot do so when it is converted into silicates, as in an hydraulic cement, whether the latter is a natural or artificial product.

(*To be continued.*)

CONCRETE SIDEWALKS.

ALTHOUGH more or less has been said on this subject in previous numbers, it may not do any harm to reiterate some of the points which are of importance in this class of concrete work and also, perhaps, to add a little new material to the subject.

The point is naturally raised by people in general as to the wear of concrete walks, and the question is often asked, "Why do these walks crack?" "Why do they go to pieces?" The answer is simple. Because the price for having them put down properly is not paid, or, if what is reasonable for a first-class pavement, is paid because the man who does the work is negligent, or ignorant, or does not furnish proper materials. Given the proper materials, it is an easy matter to construct a concrete walk, within reasonable cost, which will outwear any known paving material.

In New York there are a great number of very poor pavements. The competition is sharp, prices are low, and the work must be done within the contract price. People pay large sums for their walks, but they often get the work done by the general contractors or second parties who have their commissions to make, with the result that the work is carried out by the lowest bidder, and the consequences are discouraging.

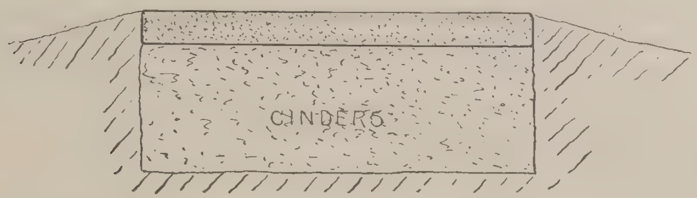
Again, the fault lies with the architect, or the engineer, or the landscape gardener, who is ignorant of a proper specification for such walks, does not know that one grade of cement is better than another for color and strength, does not insist on proper drainage and foundation, and is ignorant of the use of dryers and other means taken to avoid labor and lessen the expense. There are many people who are ready to pay even more than the ordinary rates, if they could be assured of getting the value of their money, but, unfortunately, they are not assured, under ordinary circumstances.

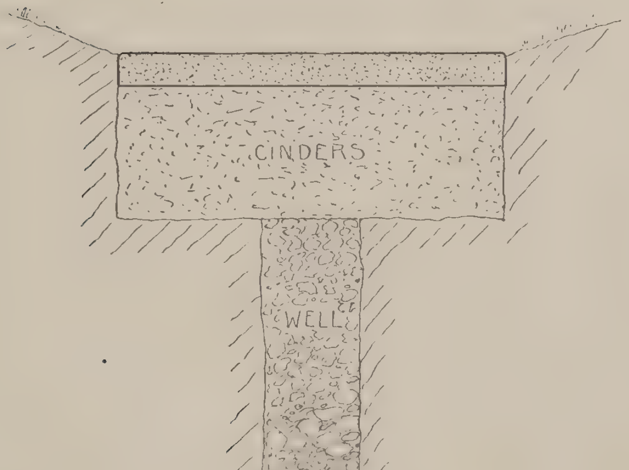
In all ordinary work, on the ground, the following is good practise and will insure success: —

1. Do not lay walks on newly made ground. Allow a year at least for settlement.

2. Excavate 18 to 20 ins. and fill the trench or excavation with (1) clean locomotive or mill cinders; (2) broken brick, pottery, and other porous material; (3) broken stone or gravel. In making the excavation, provide all the means possible for preventing water accumulating in the trench, for it will freeze and heave the walk, to a certainty.

The figures given below show the method of draining which is most satisfactory. Where the slope of the land is such that the water does not naturally flow away from the walk, wells should be dug at intervals of perhaps 20 ft., and filled with broken stone or porous material of any kind, these wells being 3 to 4 ft. deep, sufficient to go beneath the frozen surface, and permit water to drain away into the earth.





A few bars of $\frac{3}{16}$ in. square twisted iron or steel rods (Ransome), imbedded about 12 ins. apart, as near the surface of the walk as possible, will be found to furnish additional security from cracking by frost or settlement.

3. Mix the coarse concrete in the proportion of one part cement to four or five parts of coarse sand or fine gravel and four to five parts of clean 2 in. stone or screened gravel. Mix thoroughly and use a first-class cement of imported or American Portland. Wet to the consistency of a stiff dough. Put this concrete in place and tamp down thoroughly to a uniform thickness of 3¼ ins. While this is being done have the top concrete mixed, using the same cement as in the bottom. To cheapen work it is the practise to use one cement for the bottom and another for the top, but this can seldom be done successfully on account of the difference of time in the setting of the two brands.

Thus most of the cheaper cements are quick setting and the dearer ones are slow setting — in fact, this is the rough index to the grade of a cement. If a quick-setting cement is used for the coarse stuff of the bottom and a slow-setting cement is used for the fine material of the top, the result is that the bottom concrete is hard before the top sets at all, and this prevents a strong adhesion of this top layer to the bottom. Again, if the same grade of cement is used throughout, it is very important that the coarse concrete is not allowed to set before the top is put on; otherwise there is failure in the adhesion of the two layers. Presently the walk sounds "hollow" as one walks over it, and after a time the top layer begins to crack and break up. It is almost invariably the case whenever the coarse material is allowed to set before the top is put on, and great care should be taken to prevent workmen from putting in more coarse concrete than can be readily finished in the day's work. In straightaway work a first-class finisher and helper with five men ought to finish up 500 sq. ft. a day.

In the mixture for the top use one part cement to two parts of coarse sand or "wheat" stone, the latter preferred. Beach sand of coarse variety, if free from salt, makes good topping, and good clean pit sand; free from loam or dirt, will be satisfactory, but best of all is "wheat" stone of granite or other hard stone.

In the Western States granite "wheat" is almost universally used in the pavement work, and the words "granolithic" and "granitoid" are names adopted to denote this class of work, although at present "granolithic" denotes the concrete pavement, without reference to the materials of which it is made. Mr. P. M. Bruner was one of the first, if not *the* first, to use the names "granolithic" and "granitoid," and if all who have adopted these names would also adopt his method and materials we should not hear so much about poor concrete paving.

The topping should not be mixed with too much water. It is the tendency among workmen to use an excess of water, as it saves labor. The practise is to spread the soft material and allow the water to rise to the top, and then use dry cement and sand to absorb the excess of water. The custom is a bad one, for too much water drowns and injures the cement. The "dryer" is sifted on and is then troweled into the soft material below. The surface thus made is not a hard one and wears away easily. This practise is common in "rolled" work, and the softness of the surface is seen in the rapidity with which the roller marking wears away. The best surface is made by mixing the concrete to a stiff dough and troweling it on in two or more layers. This will insure a very hard surface, upon which a roller will make little impression, and years of travel will show little wear.

On the matter of coloring there is little to be said. A good quality of lampblack gives the best results in blues and slates. Reds and yellows are not wholly satisfactory, as they do not hold their brilliancy for any length of time. They are suitable, however, for some classes of work where vividness of color is not essential. In using lampblack a good deal depends on the sand, as some kinds take much more than others to get the same depth of color. Sea sand takes as much again as pit sand, for instance, varying for a moderate blue from 1 lb. to 3 lbs. of lampblack per barrel of cement.

Do not attempt to lay concrete pavements in frosty weather out of doors, for the best of care will barely protect them. There is not much danger of injuring the concrete itself, but a thin film of cement and water may freeze on the surface, and eventually this will peel off and ruin the appearance of the walk. Concrete should be thoroughly dried out before being exposed to severe cold; but, again, the injury will depend largely on the quality of cement used.

As far as the writer's experience goes, the best cement for paving is the "Germania" brand, for it makes a very white surface, very uniform and fine in appearance. It is one of the strongest and most reliable of the German cements, and is particularly adapted to pavement work. Dyckerhoff, Alsens, Star Stettin, Hilton, Brooks-Shroobridge, White Bros., and other brands of German and English Portlands have been largely used, and some American brands are finding a market among the paving men.

When a concrete walk is properly and conscientiously constructed there is no better paving material known. It is unfortunate that competition has driven a lot of inferior work into the market, for it is these poor walks that give a hurtful name to concrete in general but as the material becomes better understood and its use becomes more extended, perhaps the requirements for better work will be insisted on, and then we may look for better results.

Ross F. Tucker.

A NEW CEMENT TESTING MACHINE.

THE two types of cement testing machines most commonly used in this country to-day are the sand or shot type and the moving poise type.

In the first type, sand or shot is run into a pan at the end of the long arm of a lever, and the specimen to be tested is held in some form of grip at the short arm of the lever. The breaking of the specimen closes a valve in a spout which conveys the shot or sand to the pan.

The objections to this machine are: first, the lever becomes inclined as the load increases; second, the shot in the spout between the valve and the pan goes into the pan after the breaking of the specimen. Although this weight may be trifling in amount, yet when multiplied by the ratio of the arms of the lever it often becomes a large percentage of the breaking load, especially in the case of the weaker cements.

In the second type of machine, a heavy poise is moved along the weighing lever, thus keeping the lever balanced. As in the other type of machine, the specimen is at the short arm of the lever. In many machines of this nature the poise weighs from 18 to 25 lbs. The poise is moved by an endless cord running back to a hand wheel at the fixed fulcrum of the lever. Although the poise runs on rollers, yet a pull of two or three pounds is required to move it, and as this pull is generally exerted in a line above the line of the knife edges of the lever, it has a certain moment arm tending to turn the lever, and consequently introduces an error. This error is independent of the load, and at low loads is often a large percentage of the breaking load. At high loads the percentage is of course much smaller.

In the new form of cement testing machine, shown in the accompanying cut, the aim has been to make a machine in which the load can be applied at a definite rate and without shock, and to make use of a weighing device which will give as great an accuracy as possible and have the same degree of accuracy at all loads.

The method of holding the specimen will not be discussed, since the holders, although an essential part of a cement machine, have no influence on the manner of loading or of weighing. A description of the particular holders used will be found in the "Transactions of American Society of Mechanical Engineers," Vol. IX.

DESCRIPTION OF THE MACHINE.

The load is applied by drawing the splined screw, A, down through the worm gear, B. The worm gear is tapped to fit the screw, and acts like a nut. The screw, being splined, is kept from turning by the feather, C.

The worm gear (sixty teeth) is driven by the worm shaft, D, which makes one fourth as many turns as the driving shaft, E, on which are the tight and loose pulleys, F and G, 8 ins. diameter. The pitch of the screw, A, is ⅛ in., and 8 x 60 x 4 turns of the driving shaft are required to draw the screw down 1 in.

The driving belt runs on a 2 in. shaft, making two hundred revolutions per minute.

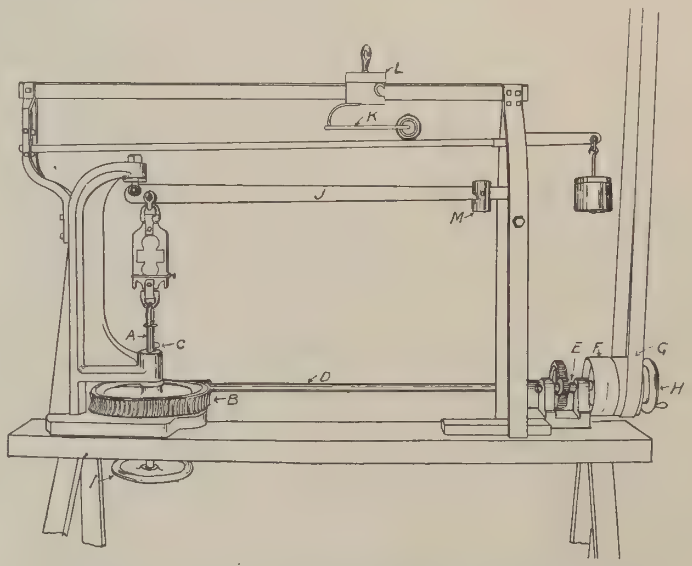
A hand wheel, H, enables the machine to be run by hand when so desired.

After breaking a specimen, the screw, A, is returned to its first position by withdrawing the feather and turning the screw up through the worm gear by means of the hand wheel, I, on the bottom of the screw. While doing this, a swivel at the upper end of the screw makes it unnecessary to disconnect the holders.

The pull exerted on the specimen is carried through the specimen to the lower lever, J, multiplying 25 to 1.

The fixed fulcrum is at the end of the lever, so that the pull of the specimen tends to throw the free end downwards. The free end of this lever connects with a second, the weighing lever, in such a way that its free end is raised with an increase of load. This lever is kept balanced as the load is put on by moving a poise along the top of this beam, which is made T shape in section.

The poise is a roller about 3 ins. in diameter, and turns on a very small steel pin. It is moved by the link, K, which connects it with the piece, L. The piece, L, runs on a fixed beam, upon which the graduations are cut. From this manner of moving the poise it is impossible to transmit any shock to the weighing beam.



With very little care the extreme motion of the end of the weighing lever can be kept inside of one quarter of an inch.

The upper beam has four graduations corresponding to four rollers of different weight. The lightest roller gives a load of 250 pounds in traversing a distance of 50 ins., and its scale reads to one half of a pound. The second roller gives a range from 0 to 500 lbs., the third from 0 to 1,000 lbs., and the fourth from 0 to 2,000 lbs.

Of course one half the weight of the link, K, is included in the weight of the roller.

In every case the lightest roller capable of breaking the specimens should be used.

The counterbalance, M, has to be moved every time a roller is changed.

The writer is indebted to Mr. J. K. Proctor, of the Fairbanks Scale Co., Boston, for valuable suggestions from which the method of weighing by the use of rollers was worked out.

The accuracy of the machine can be verified at any time by suspending sealed weights from the loop carrying the holder.

Instead of moving the poise by hand, it might be moved by electrical means, the circuit being made or broken by the motion of the weighing lever. This would leave nothing for the operator to do but to put in or remove specimens and to ship the driving belts.

This machine has been in use in the Applied Mechanics Laboratory of the Massachusetts Institute of Technology for about two months, and has worked satisfactorily.

Edward F. Miller.

The Masons' Department.

Conducted in the Interests of the Mason and the Contractor for Brickwork.

CRACKS IN BRICKWORK AND PLASTERING. WHAT CAUSES THEM, AND HOW THEY MAY BE PREVENTED.

BY A. H. DYER.

(*Continued.*)

THE previous chapters were devoted entirely to the subject of cracks that were caused by unequal settlement, resulting from a continuous or improperly proportioned footing. Although a number of different examples were used, there are many more separate and distinct cases requiring as much attention as those already mentioned, and all resulting from the same cause. Lack of space prevents a more thorough treatment at this time; but we think it has been quite clearly proven that the frequent and unconditional assertion that "the foundation is not heavy enough" is very often erroneous, and is frequently made use of as an easy way to get around a hard question. Many prospective owners of buildings have peculiar ideas of their own in regard to foundations, and, after going to the expense of employing a competent architect to prepare plans for them, they will go to still more expense in order to accomplish exactly what he, the architect, has tried to avoid.

The writer has in mind a brick building costing about $18,000, and which the owners insisted must have "a good heavy foundation"; so they disregarded the advice of the architect and expended about $1,000 extra for the privilege of having an 18 in. by 48 in. concrete foundation below the center of the large basement windows, a half dozen broken sills and lintels, and a few zigzag cracks in the brick-work; they received quick returns for their money, however, for the above result was attained before the building was ready for the plasterers.

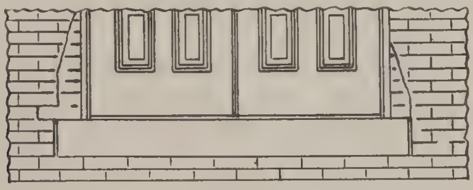


FIG. 26.

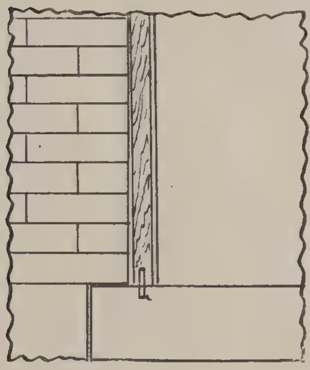


FIG. 27.

It should be remembered that the foundation should be planned for the building, and not the building for the foundation; or, in other words, the floor plans and elevations should be completed first. Then divide the elevations into panels extending from the top of wall to the bottom, and as shown in some of the illustrations. Find the maximum load per square inch in the solid panels, and reduce the area of footings below the openings to conform with that basis, and as shown by Fig. 14 and the accompanying explanations, always taking into consideration the weights of the proper proportion of floors, roof, plastering, etc., that are thrown upon each particular wall. In complicated cases the best way to do this is to divide one of the floor plans into proper sections, and mark thereon in each section the load upon each lineal foot of wall, and where it belongs, and add this amount to the weight of *brickwork alone*, when computing the load per square inch of footings. Then take the partition walls in a like manner and figure the width of these footings so that the loads per square inch will conform as nearly as possible to the loads per square inch upon the footings of the outside walls, always keeping the loads within a reasonable limit. Carefully examine the ground and see that it is of a uniform nature; figure carefully and correctly and never trust to guesswork, and with practise you will soon acquire a system of proportioning footings that will invariably insure success, *provided your plans are accurately followed.*

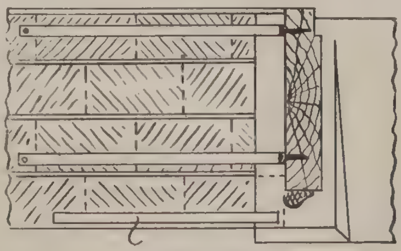


FIG. 28.

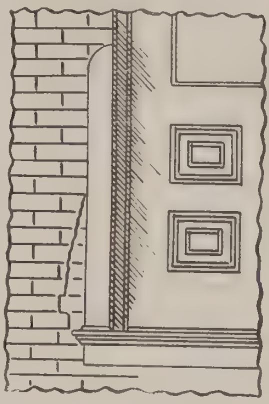


FIG. 29.

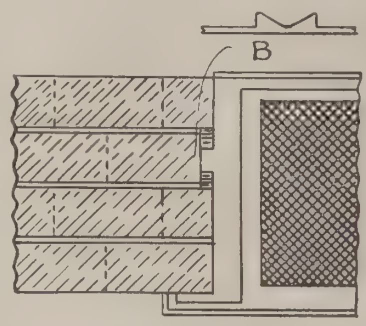


FIG. 30.

But it must be remembered that there are other cracks in brickwork for which the foundation is not in any way responsible, and which may be avoided quite easily after they are once thoroughly understood. Take, for instance, Fig. 26, which is a decided case of "contraction crack," caused by the shrinkage or contraction of the stone sill.

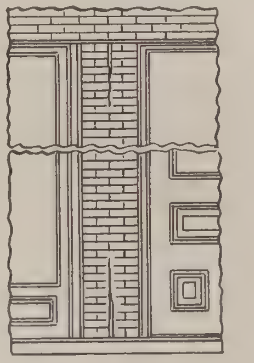


FIG. 31.

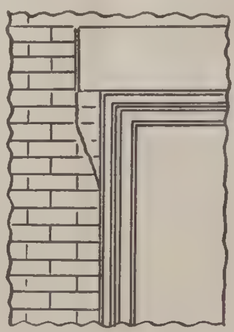


FIG. 32.

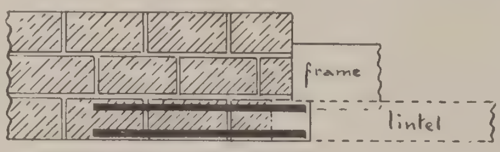


FIG. 33.

It will be noticed that the ends of sill project into the wall several inches, thereby receiving considerable weight from above, and, as the sill is shortened or drawn toward the center by the contraction, a part of the brickwork goes with it, as shown in the illustration. A contraction crack always works toward the opening, but sometimes an unusually tough brick and a correspondingly weak joint is encountered and the crack will "dodge out" and "take the joint," as shown at the left of Fig. 26, but will eventually work back toward the center again. Fig. 27 shows a very common but rather doubtful method of securing the bottom of a door frame by the use of dowel pins in the jamb and sill. When contraction occurs the bottom of frame is pulled away from the brickwork, leaving an unsightly opening, as well as causing trouble with the doors. Fig. 28 shows a good way to avoid this defect, as well as the one shown in Fig. 26. Anchor the bottom of frame to wall, *not to sill;* then lay a piece of iron, say ⅛ in. by 1½ ins. in joint, as shown by A, and keep back from edges just far enough to allow for pointing; if there be an opening below this one lay a similar piece of iron *under* sill. Fig. 29 shows a contraction crack caused by brickwork being built upon iron sill. Fig. 30 shows how to avoid it. Keep the sill between the jambs of the opening, and if considered necessary in order to keep sill from sliding have a flanged lug cast on each end as shown by B and located as shown.

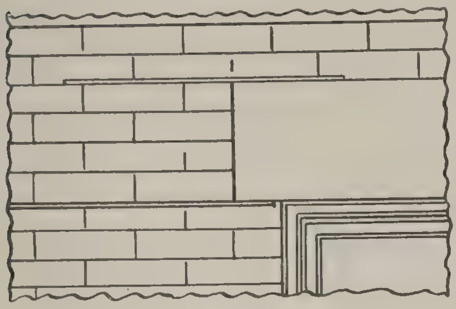


FIG. 34.

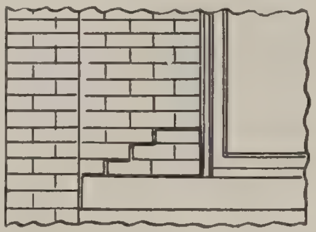


FIG. 35.

Fig. 31 shows a case noticed by the writer a short time since. A 16 in. pier dividing a store front and hallway was built partially upon two cast-iron sill plates, which joined in the center of the pier; a cast lintel was built into wall above in a like manner, and without any bearing plate beneath the joint; the result being that the top of pier was split in the center for a distance of about 2 ft. downward, and the bottom of pier was split about the same distance upward.

This was clearly the result of bad judgment, for if the sill plates had been kept entirely free from the pier and the same amount of iron which was built into pier at the bottom had been placed on top of the pier and under the joint or splice neither of these cracks would have occurred. Fig. 32 shows a contraction crack such as often occurs where either iron or stone lintels are used. Figs. 33 and 34 show how this may be avoided by laying iron into joints in a manner similar to that recommended for door sills. Window sills should be treated in a like manner, or when they run into wall not more than 1½ or 2 ins. the joint between top of sill and first brick above may be left open until the building is completed and then be pointed up on the outside. Fig. 35 shows an actual case where a sill course was built into wall along the entire front between the piers, and is a clear case of contraction crack. The sill and the three courses of brick above it were drawn out of the wall and toward the opening about ¼ in. and crowded the brick mold toward the center of the opening, while the three courses of brick remained thoroughly cemented to each other and to the sill. There are no indications whatever of any settlement, as not a single brick in the front is fractured.

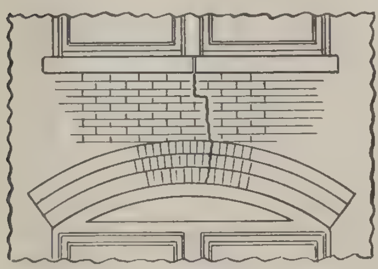


FIG. 36.

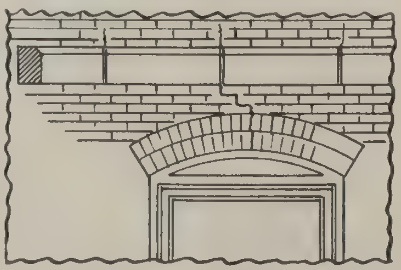


FIG. 37.

Fig. 36 shows what occurred in the wall of a three-story and basement factory building where the "isolated pier system of foundations" was used with excellent results, the cracks here shown being the only ones to be found about the building three years after it was completed. This crack was undoubtedly caused by contraction, but may have been aided somewhat by a poorly built arch below. The sill being in two pieces and firmly built into the wall at the ends, and thoroughly cemented to brickwork below caused the sills to draw *from the center* each way, as could be plainly seen, as the mortar joint still adhered to one of the ends. This sill was specified to be in *one* piece, but the two pieces were substituted as being "just as good." Now, if the sill had been in one piece and no provisions made for protecting the ends (which was done, however, in this building) the contraction would have been toward the center instead of from the center, and the result would have been similar to that shown in Fig. 26.

Fig. 37 shows a very usual occurrence where a stone water table is used and the joints are not protected (note cracks above stone as well as below). It must be remembered, however, that in cases like 36 and 37 these cracks may be aggravated, or partially caused by "unequal settlement," as well as by contraction, and in that case they would properly be called "combination cracks."

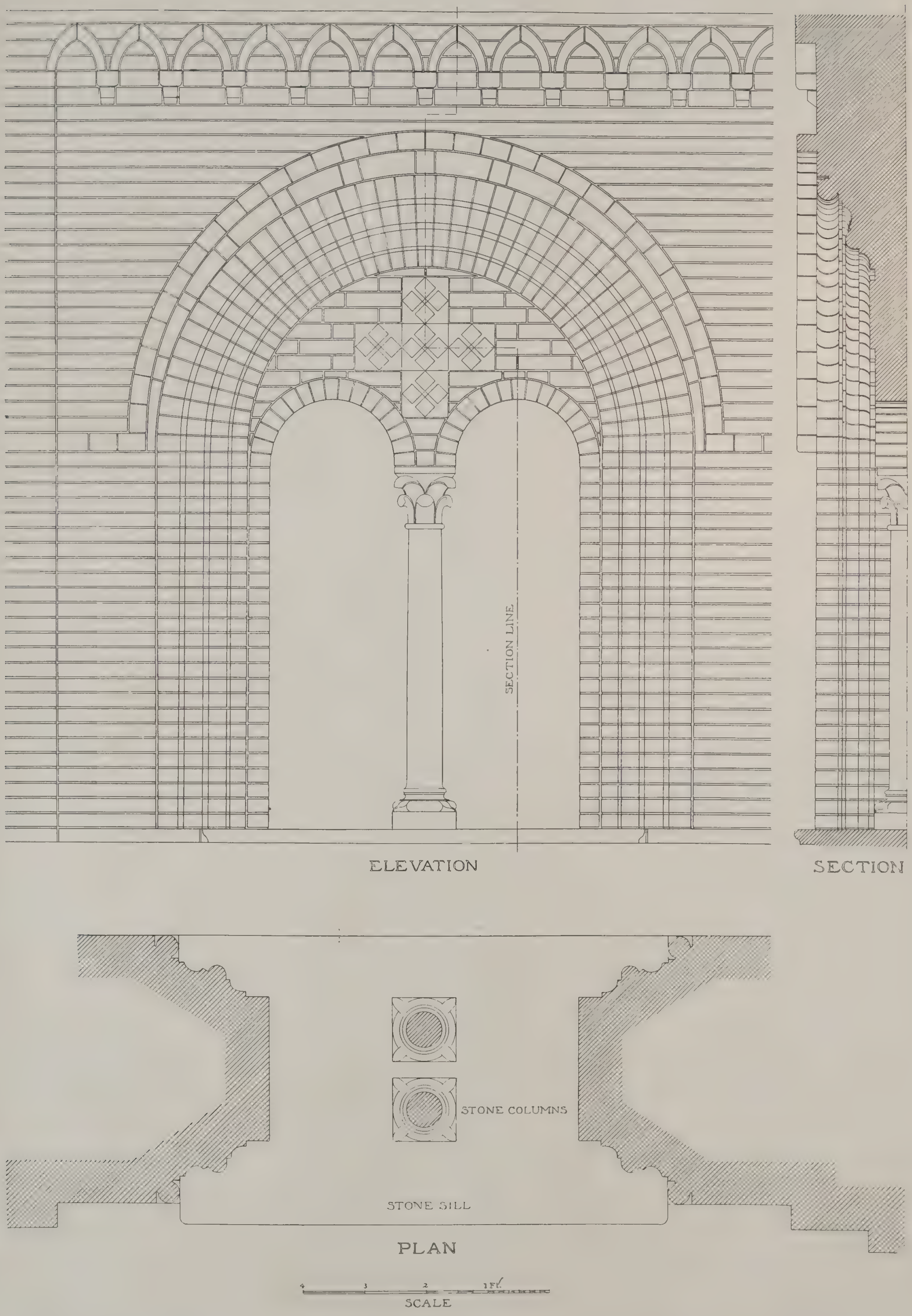
(*To be continued.*)

ARCHITECTURAL TERMS EXPLAINED.

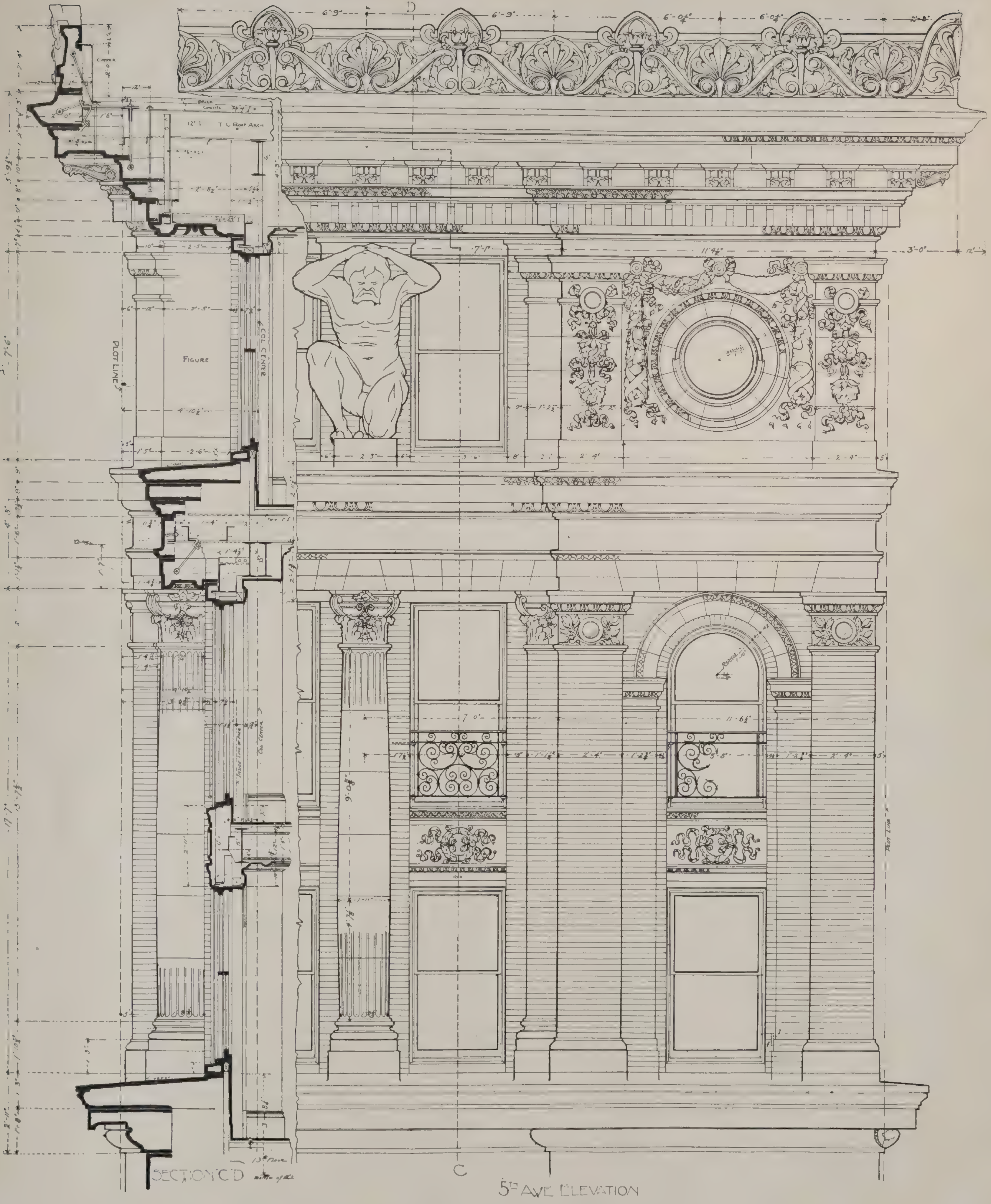
THE following explanation of the various phrases used by architects, and not generally fully understood by the mechanic, may prove beneficial to many.

The *front*, or *façade*, made after the ancient models or any portion of it, may represent three parts, occupying different heights; the *pedestal* is the lower part, usually supporting a column, and its place supplied by a *stylobate;* the stylobate is either a platform with steps or a continuous pedestal supporting a row of columns. The lower part of a finished pedestal is called a *plinth*, the middle part is the *die*, the upper part the *cornice* of the pedestal, or *surbase*. The *column* is the middle part, situated upon the pedestal or stylobate. It is generally detached from the wall, but is sometimes buried in it for half its diameter, and is then said to be *engaged*. *Pilasters* are square or flat columns attached to walls. The lower part of the column when detached is called the *base;* the middle or longest part is the *shaft*, and the upper or ornamental part is the *capital*. The swell of the column is called the *entasis*. The height of columns is measured in diameters of the column itself, taken always at the base. The *entablature* is the horizontal continuous portion which rests upon the top of a row of columns. The lower part of the entablature is called the *architrave*, the middle part is the *frieze*, while the upper or projecting part is the *cornice*. The *pediment* is the triangular face produced by the extremity of a roof. The middle or flat portion enclosed by the cornice of the pediment is called the *tympanum*. Pedestals for statues erected on the summit and extremities of the pediment are called *acrosteria*. An *attic* is an upper part of a building, terminated at the top by a horizontal line, instead of a pediment.

The different moldings in architecture are described from their sections or from the profile which they present when cut across. Of these the *torus* is a convex, but its outline is only quarter of a circle; the *scotia* is a deep concave molding; the *cavetto* is also a concave and occupying but quarter of a circle; the *cymatium* is an undulating molding, of which the upper part is concave and the lower convex;

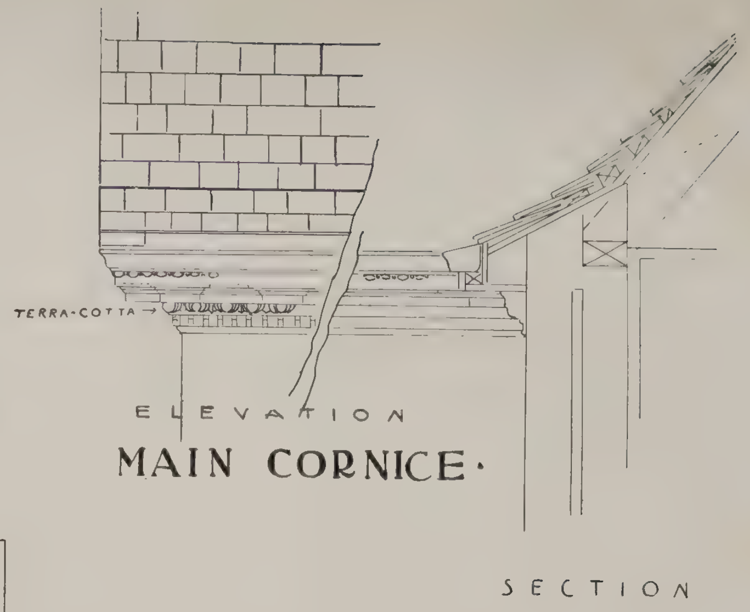


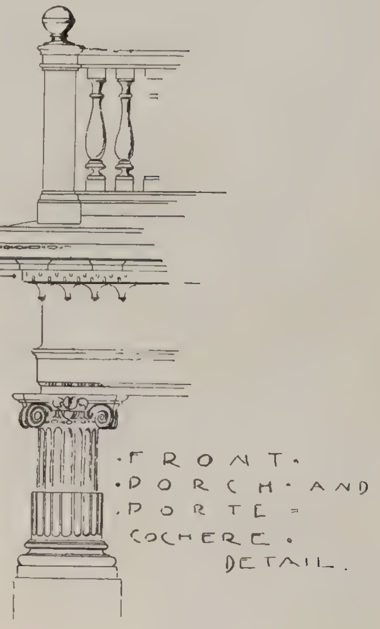
MEASURED DRAWING OF WINDOW IN TOWER OF MONASTERY CHURCH AT CHIARAVALLE.

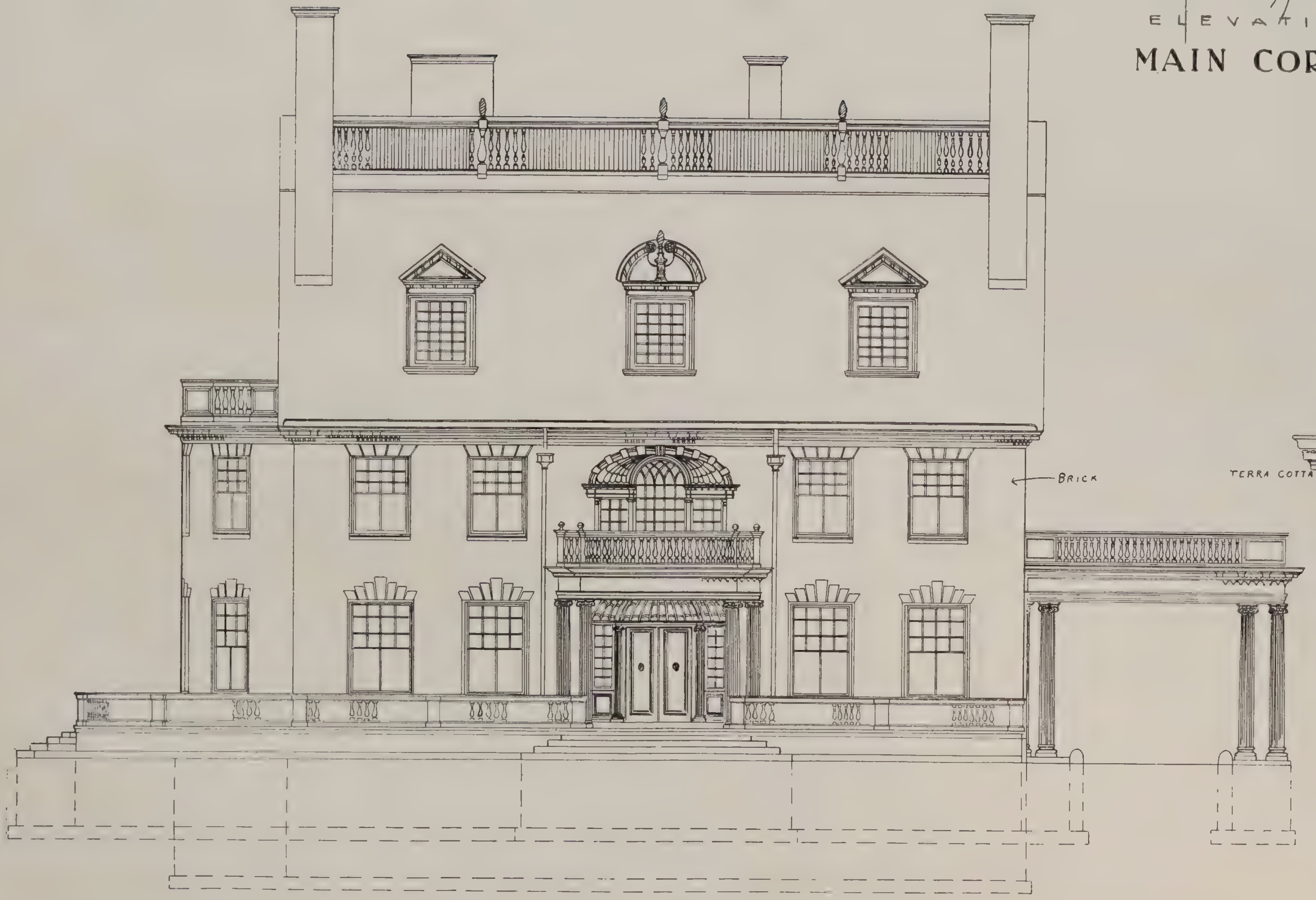


PARK BUILDING, PITTSBURG, PA. Details of Terra-Cotta Work.

GEORGE B. POST, Architect, New York.

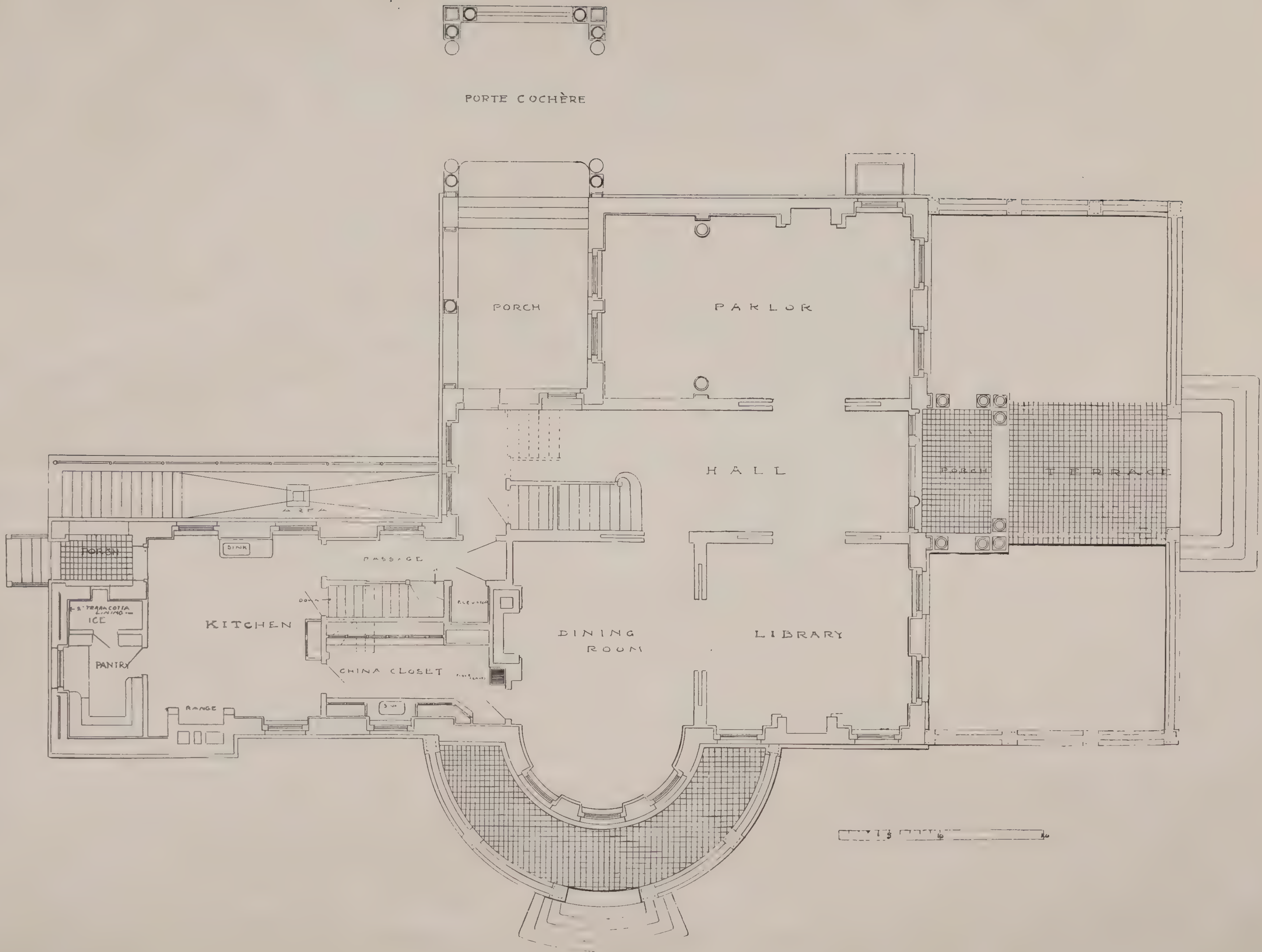






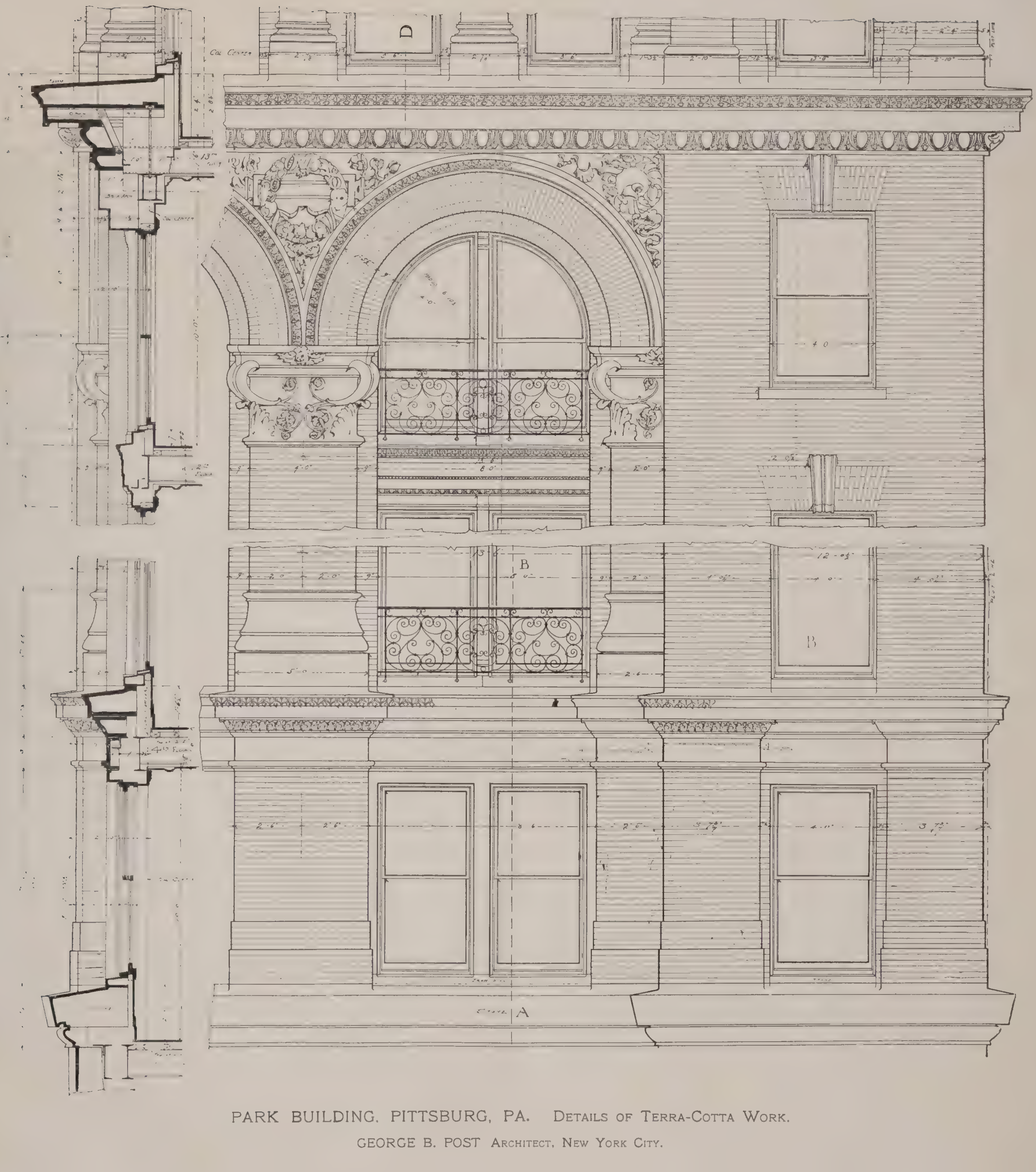
RESIDENCE FOR MRS. SUSAN HOLMES, PITTSBURG, PA. FRONT ELEVATION.

PEABODY & STEARNS, ARCHITECTS.



RESIDENCE FOR MRS. SUSAN HOLMES, PITTSBURG, PA. First Floor Plan.

PEABODY & STEARNS, Architects.

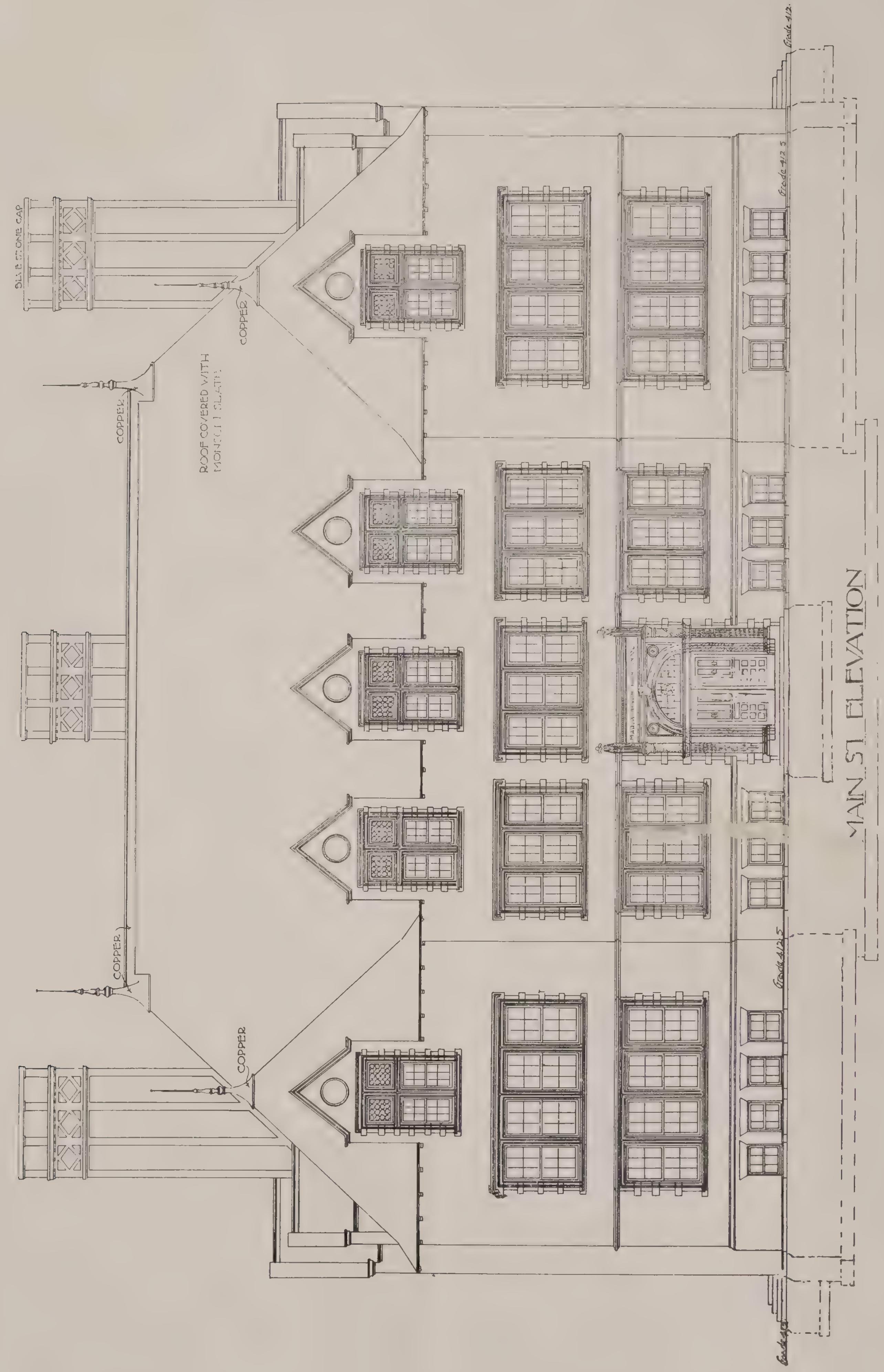


PARK BUILDING, PITTSBURG, PA. Details of Terra-Cotta Work.

GEORGE B. POST Architect, New York City.

THE BRICKBUILDER.

VOL. 4. NO. 12. PLATE 80.



HIGH SCHOOL BUILDING, MARLBOROUGH, MASS.

WHEELWRIGHT & HAVEN, ARCHITECTS. BOSTON.

the *ogee*, or *talon*, is an inverted cymatium; the *fillet* is a small square or flat molding.

In architectural measurement a *diameter* means the width of a column at its base. A *module* is half a diameter, and a *minute* is a sixtieth part of a diameter.

BRICKWORK IN WINTER.

IN building in the winter and frosty weather the brick should be kept perfectly dry, and for work that must be accomplished at this time of the year the mortar should be used immediately as made; but the use of frozen mortar tempered up cannot be too much deprecated, as well as brick that has been wet and frozen and laid in that condition.

There is risk in using common mortar in cold weather. If the cold should continue long enough to allow the frozen mortar to set well, the work may remain safe; but if a warm day should occur between the freezing and the setting of the mortar, the work is apt to be weakened. Mortar which has partially set while frozen if then melted will never regain its strength. Strong hydraulic cements seem not to be injured by freezing. Experienced contractors assert that adding salt to mortar in cold weather to preserve it from the bad effects of freezing has been found beneficial. It is not quite clear why the salt should act in this way, as the beneficial results of using it are visible with mortar that has certainly been frozen, and frozen salt water expands nearly as much as fresh water. But engineers and contractors who have tried it are unanimous in their opinion of its value. Many cases may be cited where masonry has been laid in cement in cold weather, using a considerable amount of salt in the mixture, which after repeated freezing and thawing has remained in perfect condition, while work near by laid in mortar of the same kind, but without salt, has been disintegrated by the frost.

We know that good results have been attained with brickwork in frosty weather, when the lime has been slaked and immediately made into mortar and used in a warm condition; for the dry nature of the brick absorbs the water that may be in the mortar, and cohesion takes place before the frost can accomplish much injury. It is said that in Norway, at Christiana, building operations are carried on successfully when the temperature is as low as 12 degs. above zero Fahrenheit, and that the work executed under these conditions compares favorably with summer work. In fact, the Christiana builders claim it is superior. The secret of successful work under these conditions is said to be in the use of unslaked lime, in mixing the mortar in small quantities at a time, being made up immediately before use.

The mortar must be put in place before it loses the heat due to the slacking of the lime. The lower the temperature the larger the quantity of lime required, so that below 12 degs. Fahrenheit the work cannot be carried on profitably.

In the winter it is very necessary to preserve the unfinished walls from the alternate effects of rain and frost, for if it be exposed the rain will penetrate into the bricks and mortar, and by being converted into ice will expand and burst or crumble the material in which it is contained, and is liable to leave a dark streak of discoloration where the work is left off. Consequently, as soon as cold and stormy weather sets in it is best to take extra precautions in covering the walls. Pieces of old sail cloth make an excellent covering, are handy to use, and with proper care will last for years.

CORRECTION.

IN the diagram of the chimney built by D. J. Curtis, shown in the November number, the diameter of the flue was given as 13 ins. This was an error, the diameter being 33 ins.

A GOOD plan in building brick piers is to leave the inside of the pier half a course below the outside or shell, leveling up every five courses for headers.

BRICKS LAID BY MACHINERY.

SOME ten years ago an ingenious resident of the Nutmeg State conceived the idea of laying bricks by machinery, and thereby greatly reduce the cost of brick building, as well as the time required in laying by hand.

Having conceived so brilliant an idea, he proceeded to construct a device to make it practical, and which, it was reported, he took the caution to have patented. It consisted of a series of arms or supports, from which was hung a car or truck which ran from one end of the wall to the other, and on this car was carried the materials,—brick and mortar.

The mortar was carried to the wall from the truck by means of a hose or tube, which could be so regulated as to control the flow of mortar, making the joint thick or thin, as the case required. This was followed by a "spreader," which spread the mortar, and a "cutter," which cut it off after the brick was laid.

The machine was so arranged that it could be moved 4 or 8 ins. at a time. It was reported that the first time this device was used in practise was on the second story of a large factory building. After many attempts, the apparatus was finally placed in position and the fun commenced. Occasionally a stone in the mortar would cause trouble, or a brick with a corner chipped off would be laid in the front of the wall. With considerable patience and the assistance of three or four bricklayers, the wall was finally run up "sill high." The sills were set and on these the window frames were placed. When the inventor was told he could proceed with the work he was at a loss what to do, as he hadn't thought about the "windows being in the way."

Reliable and trustworthy people passing the building at the time say that Smith's bricklaying machine was seen taking a tumble over the wall, and some even go so far as to say the inventor went with it.

Useless as this device proved, it opens up the query, Will brick ever be laid otherwise than by hand?

We are inclined to think, after carefully considering the question, No. Notwithstanding the rapid strides we are making in the way of improved and labor-saving devices used in building, the peculiar requirements demanded of any device for laying brick in all positions and places makes the possibility of producing such a machine very doubtful, indeed.

The man who can give us a machine that will do the work of the bricklayer, and do it faster, better, or cheaper, will, indeed, be the marvel of the age, and will be entitled to be classed with Edison, Morse, or Hoe.

THE increasing values of land in our cities have forced owners of real estate to adopt plans that will utilize all the available rent-producing space both above and below ground. Our modern high office buildings permit the utilization of nearly as many square feet on each floor as there are in the lot on which the building stands. This is accomplished by constructing thin walls on a steel supporting frame.

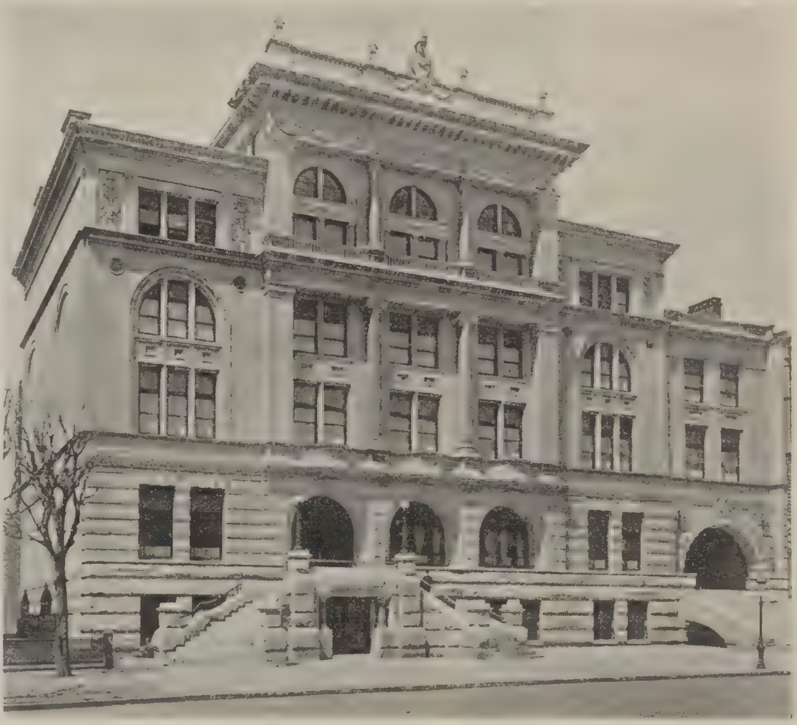
The introduction of the steel frame in water-proof cellar work in order to obtain the greatest available floor area in cellars, basements, and boiler-rooms has recently been made by a Boston builder, named Frank B. Gilbreth. Mr. Gilbreth's method is unquestionably one of the best, if not the best, and cheapest method of making cellars absolutely water-proof below water.

A NOVEL method of constructing a round brick stack, which adds materially to its stability, has recently received a practical test by a well-known architect in Massachusetts. The only difference between the new method and the ordinary manner of construction is that the first course in both the inner and outer walls is started with what is commonly termed "a hog in the wall," thus making the course continuous, like a corkscrew or spiral spring, to the top, where the "hog" may be cut out and the chimney leveled up for the cap. The originator of the idea claims great advantages for this style of construction.

Recent Brick and Terra-Cotta Work in American Cities.

A Department Devoted to the Interests of the Manufacturer.

PHILADELPHIA.— There are the usual number of rumors of large building operations for the spring of next year. A bachelors' apartment and baths, a law building, a new club house near Eighth and Walnut Streets, and several others are amongst the proposed projects; meanwhile the present operations in large buildings are going ahead smoothly, and several of them will soon be opened for business. The University of Pennsylvania is still pushing the operations upon their grounds and at Overbrook, where there is being built an observatory for the research into astronomy and the residence of the professor. Their latest project upon the grounds in this city is a building for the School of Architecture, which will be pushed to completion as soon as possible, the demands of the school having increased so as to require at once larger and more extensive quarters. The dormitory buildings are just beginning to show their beauty, and will be ready for the next term of the college year. The William Pepper Memorial Laboratory for the research into hitherto unexplored portions of medical science has just been dedicated; it is from the designs of Messrs. Cope & Stewardson, as are also the addition to the hospital and the dormitories. The Astronomical Buildings are by Mr. Edgar V. Seeler, and the building for the School of Architecture will be designed by Messrs. Cope & Stewardson, Frank Miles Day & Bro., and Wilson Eyre, Jr., associated architects.



MERCANTILE CLUB, PHILADELPHIA.

Baker & Dallett, Architects. Terra-cotta by the Perth Amboy Terra-Cotta Company.

The jury of award for the prizes offered for the best designs for the Art Museum in Fairmount Park have met and made their awards, and the Park Commissioners have given the prizes according to their decision; they are as follows:—

First prize, $6,000; James Brite & Henry Bacon, New York.
Second prize, $3,000; Lord, Hewlett & Hull, New York.
Third prize, $2,000; Marcel Perouse De Monclos, Paris.
Fourth prize, $1,000; Howard & Caldwell, New York.

As usual, there is considerable grumbling amongst the members of the profession in this city who were in the competition and did not receive any of the prizes, and some of them have, as usual, rushed into the newspapers with their designs and arraigned the judges, commissioners, and all who had anything to do with the awards. Perhaps, after all, the best thing to do is to remain out of architectural competitions.

It appears thus far that the judges have done their full duty in making the awards, and it is scarcely probable that there could be any partiality shown; for we understand that they were unanimous in their decisions, and the Park Commissioners, we think, have done wisely to accept their report and award the prizes according to their recommendations.

We hope soon to see the advance operations for the building well under way; the building is sorely needful to the city, and cannot come too soon.

The illustration this month is a good photograph of the Mercantile Club, situated on North Broad Street, and previously mentioned in this journal.

CHICAGO. A strong reminder of the great fire visited Chicago last month. Two conflagrations in a manufacturing district near the heart of the city were separated only a few blocks in distance and a few days in time. In one case a half dozen lives were sacrificed under falling walls.

Both the buildings (one was a block of buildings where brick party walls did not prevent a spread of the flames) were of "mill construction" and were occupied by manufacturing concerns. One result of these disasters was to cause a little temporary agitation of fire-escape questions,— one of several particulars we have noted in which Chicago building ordinances are openly evaded.

An item of concern to building interests is a test made Thanksgiving Day by the fire department, in which Chief Swenie demonstrated the ability of his forces to take hose to the top of the Masonic Temple, 320 ft. above the street, and throw a strong stream of water.

What might have been another building disaster, worse even than the million-dollar fires, seems to have been averted by the taking down of a building which threatened to collapse. A seven-story "mill-construction," factory building, of about 50 ft. frontage and 200 ft. depth, which has been finished within a year, was found to be settling in an alarming manner. When the tenants were ordered out the long party walls were as much as 14½ ins. out of plumb. The floors were shored from basement to roof and now as the walls are being taken down the floors have the appearance of a pile of bed springs — the piles of blocking forming the springs. The evidence so far published leads to the belief that the thirty thousand dollar loss to the owner of this building was caused by poor foundation concrete and faulty design as well.

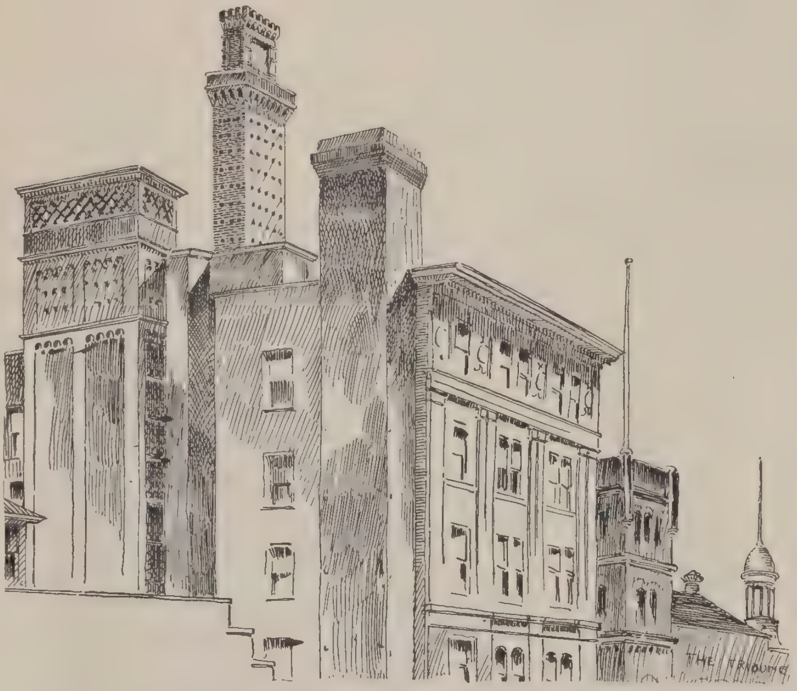
THE BRICKBUILDER made mention in its columns some time since of a project to move a large church at Twenty-third Street and Michigan Avenue.

The big irregular pile, 160 ft. long by 90 ft. wide, is now on its travels. Careful preparations were made in the way of filling arched openings with timber bracing, and tying the walls under the clear roof span with long rods, etc. Wood and steel beam blocking was used, making such a multiplication of parallel tracks that one could imagine he saw a church traveling on Ead's ship railway. Under the spire and heavier parts of the church 1½ in. steel rollers carried the weight on steel rails. The three-story brick rear extension of the church moved along on 5 in. draw wood rollers over wood beams.

No crack in the rambling structure was visible to the writer, when more than half the trip of 50 ft. had been accomplished.

Chicago is proud of her promising young sculptor, H. A. MacNeil, who has just won a "grand prix," a four years' scholarship to Rome. He is an instructor in the Art Institute, and has won compliments on his historical relief panels cast in bronze for the entrance of the Marquette Building. He has made some special study of the Indian, and his studio shows interesting results of his visit to the Zunis this last summer.

The Municipal Improvement League, made up in part of artists and architects, and of which an architect is president, promises well. They aim to see established, among other things, a censorship over art in public buildings, and, more immediately, over statuary in public parks. The league is agitating also questions as to methods of treatment for the new Lake Front Park, which is to be made by filling in part of the present harbor. A committee of twelve architects and artists are studying problems involved, so as to prevent, if possible, a solution which might cause Chicago a century of regret. The Architectural Club intends to work on competition problems (assumed) of bridges and various buildings for the new park.



PHŒNIX BUILDING.

MINNEAPOLIS. Building matters here may now be said to be in winter quarters, or as far as they generally go in that direction, at least.

Our city council has just had a section of Bridge Square paved with vitrified brick, as a test, three different makes of brick being used,— the Anderson & Barr Clay Company's, Streator, Ills.; Purington Company's, Galesburg, Ills.; and the Capital City Brick Company's, of Des Moines, Ia. The result of this test will be watched with interest, as it will probably decide whether our city will make any further use of brick as a paving material. There will probably be 200,000 sq. yds. of paving done here next season on our leading business streets.

The Park Board has decided to purchase the Exposition Building and use it in various ways for city purposes. The large auditorium will be preserved intact, the balance devoted to hospital, fire department, and other purposes. It is built of buff brick and terra-cotta, with stone trimming, and cost about $250,000 to build, and is one of the landmarks of the city, occupying the site of the old Winslow Hotel, the first hotel building erected here, about forty-five years ago.

TOWN HALL, LINCOLN, MASS.
H. Langford Warren, Architect.

The subject I have chosen for special mention this month is the new Phœnix Building, just completed, the best example of thoroughly fire-proof construction in the Northwest. Built by the New England Association; James C. Plant, architect.

This building has literally arisen from the ashes of the old Tribune Building, which was destroyed by fire just six years ago, December 1. It is nine stories and basement in height, the basement and first story built of Joliet limestone, balance of Anderson red pressed brick, with terra-cotta ornamentation and cornice.

An interesting feature is the treatment of the boiler chimney and elevator shaft, which are shown in accompanying sketch. The chimney is topped out after the manner of the tower of the Palazzo Publico, at Sienna, with common brick.

There is no wood used in the building aside from doors between halls and offices and the external sash. The doors between offices are the Richardson Fire-proof Door,— a Minneapolis invention and manufacture, which has met with universal approval from insurance companies, architects, and every one interested in fire-proof construction. It consists of a wooden case painted with fire-proof paint, and covered with asbestos paper, the exterior being one sheet of cold-rolled and pickled steel, with panels pressed into same. The edges are covered by a band of same metal, fitted into a groove in frame, making a smooth and flush finish, which is then copper plated, and given any desired finish. The door has withstood the most severe fire tests successfully, without warping or cracking.

All floors are of cement tiles and mosaic laid on concrete base. The stairs are of cement, and all door trim and room bases are run in cement.

The wainscot and floors in main entrance hall are of marble mosaics, carried up with a sweep at all angles and over window stools, etc., making a very neat finish.

All partitions are of 4 in. terra-cotta, on which ordinary lime plaster is directly applied. The roof is of terra-cotta arches and concrete, finished with Portland cement.

The burglar-proof vaults in Union Bank are of chrome steel, and masonry of paving brick, laid in Portland cement.

Fire-proofing was furnished by Pioneer Fire-proofing Company; terra-cotta, by Northern Hydraulic-Press Brick Company.

All partitions, bowl slabs, etc., are made of cement, instead of marble.

Two Crane elevators are used.

The insurance for this building was placed with board companies for three years, at rate of fifty cents, notwithstanding its immediate proximity to a theater. This is the lowest rate on any nine-story office building in the United States, the regular rate for this particular location being eighty-five cents.

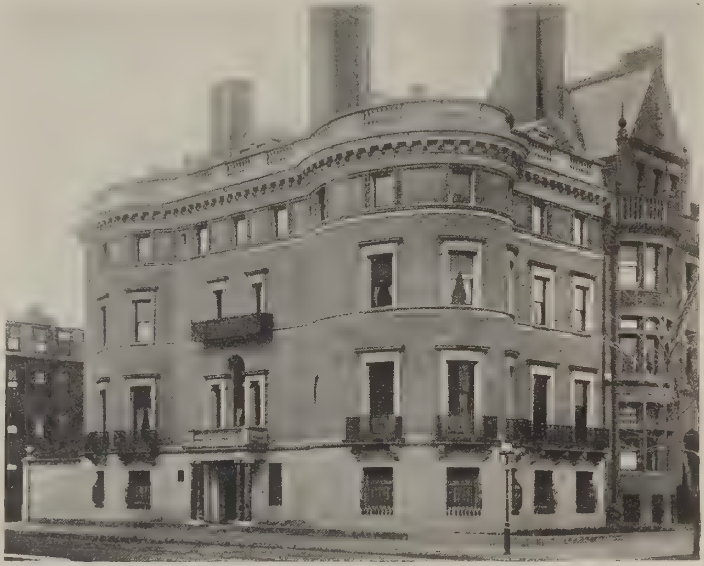
The floors and counters in the banking rooms are of cement, the latter built up of porous terra-cotta blocks. The idea of making counters in this manner is a novel and original one, and constitutes an important element in the safety of building.

THE MANUFACTURER.

THE Tenth Annual Convention of the National Brick Manufacturers' Association was held in Atlanta, Ga., December 3, 4, 5, and 6.

The following list of officers was elected for the ensuing year:

President, R. B. Morrison, Rome, Ga.; first vice-president, George M. Fiske, Boston; second vice-president, Raymond C. Penfield, New York; third vice-president, Edward Orton, Jr., Columbus, Ohio; secretary, Theodore A. Randall, Indianapolis, Ind.; treasurer, John W. Sibley, Coaldale, Ala.



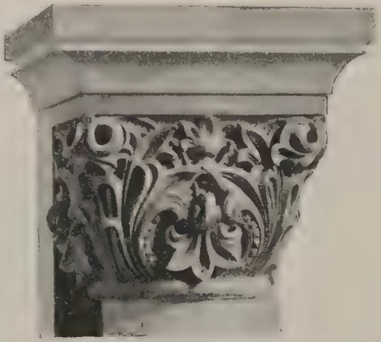
ANDREW HOUSE, COMMONWEALTH AVENUE, BOSTON.
McKim, Mead & White, Architects.

The convention was largely attended by many of the leading clay workers of the country, and was, as usual, a complete success in every particular.

The papers read before the convention were of a most interesting and instructive nature, and the discussion which followed the reading of these papers was of the character that has already stamped the members of this association as liberal and progressive men.

The banquet was as usual the brilliant feature of the convention, and was enlivened by speeches that were full of patriotism, wit, and humor.

The full proceedings of the convention may be found in the *Clay-worker*, which is the official organ of the association.



TERRA-COTTA CAPITAL.
Executed by the Northwestern Terra-Cotta Company.

AN ideal, up-to-date brick plant is that of the Akron Hydraulic-Press Brick Company, the youngest member of the extensive Hydraulic family.

The plant is situated about midway between Akron and Cleveland, Ohio, and is one of the best equipped establishments for brick making in this country.

It differs from the conventional "brick yard" in that its houses are all built of brick and filled with ponderous machinery which is used for making the bricks. Like the other members of the Hydraulic family, the Akron Company make bricks of various colors and shapes; but the destinctive color of their product is that of a bright, warm red. This particular brick has contributed very materially to the architecture of several Western cities.

Mr. William H. Hunt, who enjoys the distinction of being the youngest manager in the Hydraulic family, has charge of the Akron Company.

THROUGH its secretary, Mr. George W. Callender, we are authorized to extend to the clay workers of the United States who may visit England a cordial invitation to visit the Institute of Clay Workers, No. 222 Strand, London, W. C., where they may see what is being done by the clay workers of that country. The Institute, which was established largely through the efforts of our esteemed contemporary, the *British Clay Worker*, is in a most flourishing condition, and is patronized not only by clay workers but by architects. Among the features is an exhibit of specimen bricks made in all parts of the world, and American manufacturers are invited to send samples of their product for this purpose.

CONVENTION ECHOES.

To the National Association of Brick Manufacturers more than any other single agency, aye, more than all other agencies combined, is due the wonderful impetus the last ten years has given to the material growth of our industry.

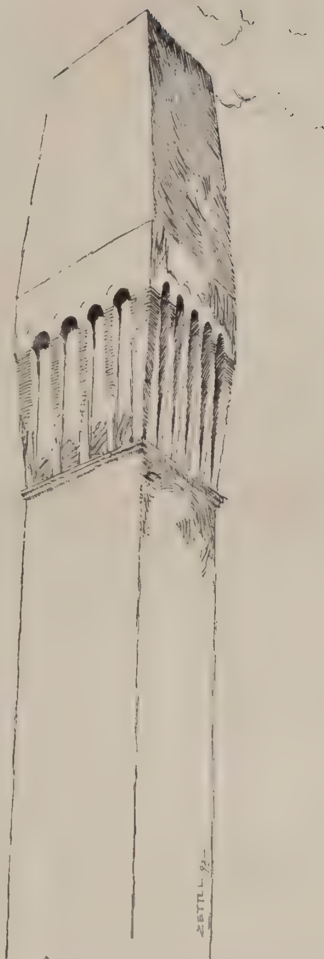
It is fair to say that the organization of this association in Cincinnati sounded the keynote of progress in the clay-worker's art.— *Purington.*

THE coming prosperity in the South, the prosperity that is here is, in the light of subsequent events as we view them to-day, the natural result of the preservation of the Union and the abolition of slavery. Open the windows of heaven on any land that is blessed as is the South, with such material resources, and let in the light of liberty, justice, equality, enterprise, and energy, and happiness, and prosperity among the people will follow just as surely as the flowers of spring come in answer to the sunshine and the rain. — *Fiske.*

LET us make our nation a place where the bonds of good government shall be felt by every association of man with man; with the spirit of justice pervading all our laws, and equity and fair dealing the rule of guidance. Let us encourage a respect for the civil authorities. Encourage social order. Let us use the great power of this government in upholding the weak, and restraining the strong, and throwing the protecting arms of this nation around the helpless and unfortunate, and laying its avenging hand upon the criminal and the lawless.— *Adams.*

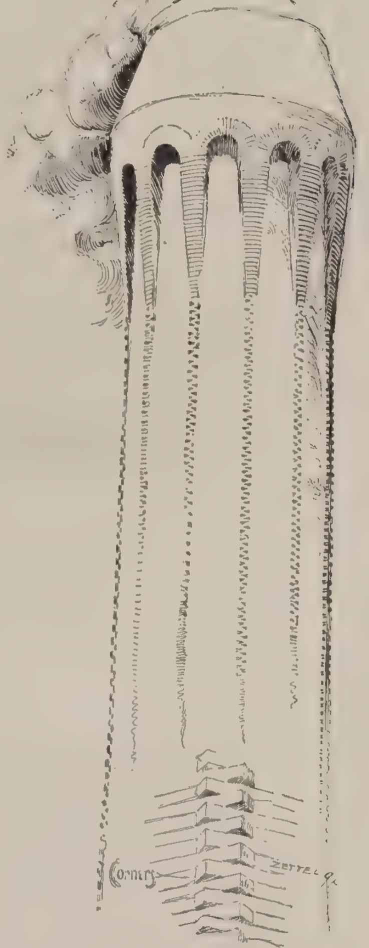
WHEN I look upon a building that has stood for two hundred years I look upon it with awe. I have a reverence for anything that is ancient, especially in the shape of a structure, and they can only be built with brick, terra cotta, and tile. Everything that clay enters into the construction of is the most enduring material, not excepting any material that you find in the encyclopedias or the dictionaries.— *Ittner.*

LAST winter I had an invitation from the Sketch Club in Chicago to read a paper to them. I felt honored by the invitation and I tell you I didn't take any chances. I sat up nights and prepared that paper and when the evening came it was stormy, and I took three of those young men to dinner and took them down to the club, so that I could have some one to read the paper to.— *Gates.*



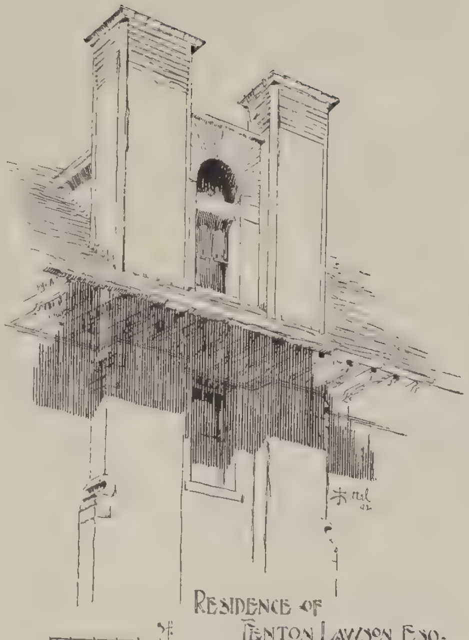
CHAMBER OF COMMERCE
CINCINNATI

Approx Scale 5 10 ft

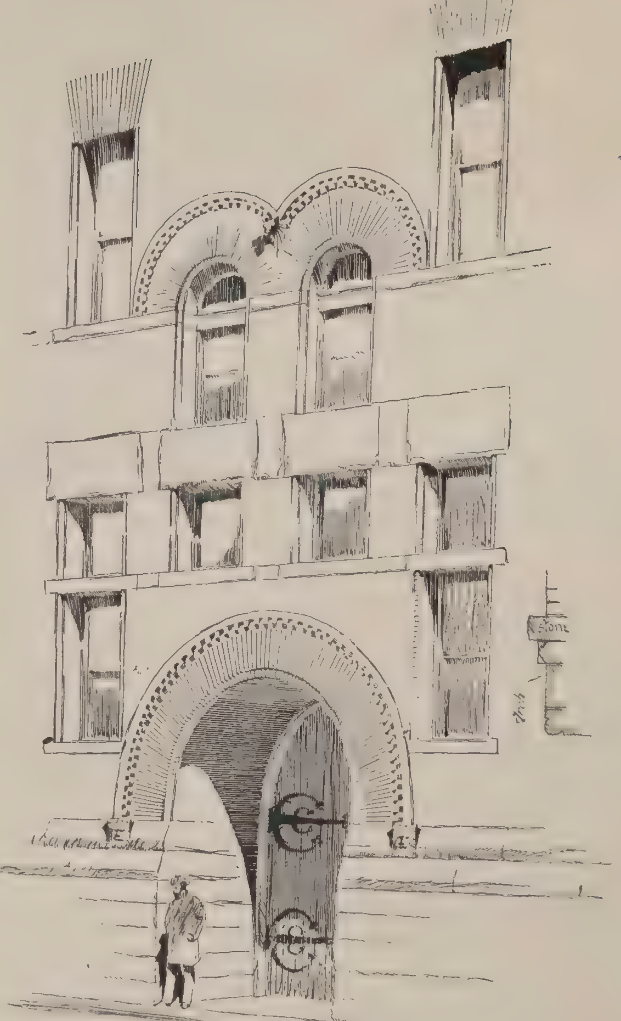


ELECTRIC POWER HOUSE
GRAND CENTRAL DEPOT

Approx Scale 5 ft



RESIDENCE OF
FENTON LAWSON, ESQ.



ENTRANCE - TENTH DIST. SCHOOL
CINCINNATI

SKETCHES OF SOME CINCINNATI BRICKWORK.

OF INTEREST.

THE POWHATAN CLAY MANUFACTURING COMPANY, of Richmond, Virginia, realizing the importance of dealing direct with the consumer, has cancelled all of its agencies, and in the future all sales of said company will be negotiated from the home office at Richmond.

The sales department of the company will be under the management of Mr. F. H. S. Morrison, formerly of Lippincott & Morrison, of Baltimore, Md., who has entered upon his duties, and who will give all matters connected with this department his personal attention.

We are further informed of the intention of said company to manufacture CREAM WHITE BRICK only, which is made necessary by the great popularity of and steadily increasing demand for these brick, in the markets of New York and elsewhere.

Brick manufactured by this company are pure in color, unsurpassed in workmanship, and guaranteed not to change color when exposed to the action of the weather, which, combined, have earned for them the well-merited commendation of the leading architects of the country.

THE new catalogue issued by J. W. Penfield & Son is the largest and most complete catalogue of clay-working machinery that has ever come to our notice. After perusing its pages, which are beautifully gotten up, one feels as if he had been spending the time in going through a large machine-making establishment, and seen the real machines, so true are the illustrations to the originals.

The volume would prove a valuable text-book to any one interested in clay-working machinery.

THE city of Lexington, Ky., is about to rebuild several of its larger streets, and in doing so will use large quantities of vitrified paving brick and sewer pipe. The work will be carried on during the winter and spring months, under the directions of the city engineer, who, by assuming the charge of the work instead of letting contracts out to paving companies, will give employment wholly to home labor.

Brickmakers, Your Interest
demands of you that you peruse the following
Announcement:

WE manufacture the Kulage Brick Press, which is the celebrated "Triumph" Dry Clay Press Brick Machine.

We guarantee that this press has not its equal. The "Triumph" has a capacity up to 35,000 plain or shaped pressed bricks in ten hours — has four distinct or quadruple pressures — has solved the problem of a twin, or top and bottom pressure without the center seam streak or granulation; is simpler — stronger — and built upon better scientific principles than any other dry clay brick press on the market. The price of a "Triumph" press is $5,500, which entire amount may be saved or gained during the first year in the superior quality of its product, capacity, and economy of operation, and comparing same with other presses.

We construct and equip brick plants of any capacity complete, and in this connection would say that we manufacture the "Triumph" Gathering and Loading Machine — also a money-maker for the brickmaker. This machine gathers the previously plowed and dried clay from the field, and loads same into carts or wagons. With two or three horses and one driver, its capacity is the gathering and loading of as much clay as twenty men with shovels would do. The profits and advantages obtained by the use of this machine are enormous.

Valuable information for progressive brickmakers — capitalists — and syndicates may be had by addressing:

Kulage Machine Works,
College Avenue and North Broadway, St. Louis, Mo.

HERE IS ONE

Representation of a FIREPLACE MANTEL. Our Sketch Book, containing 39 others, will be sent you on application.

JUST
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FIREPLACE MANTELS
MADE OF MOULDED BRICK

In such Colors as Red, Cream, Buff, Pink, Brown, and Gray. These Mantels cost no more than other kinds, but are far better. They are easily set, and have a richness and simplicity of effect which is decidedly pleasing.

PHILA. & BOSTON FACE BRICK CO.,
No. 4 LIBERTY SQUARE, BOSTON, MASS.

DYCKERHOFF PORTLAND CEMENT

Is superior to any other Portland Cement made. It is very finely ground, always uniform and reliable, and of such extraordinary strength, that it will permit the addition of 25 per cent more sand, etc., than other well-known Portland Cements, and produce the most durable work. It is unalterable in volume and not liable to crack.

8,000 barrels have been used in the foundations of the Bartholdi Statue of Liberty, and it has also been used in the construction of the Washington Monument at Washington.

Pamphlet with directions for its employment, testimonials and tests, sent on application.

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IMPORTERS OF

"GERMANIA" (German Portland Cement).

Positively the best sidewalk cement made.

This statement is based upon reports from consumers throughout the country.

Germania was selected in preference to all others for use in laying the walks in front of the White House, at Washington, on account of its almost perfect color and great durability.

FOR CONCRETE FOUNDATIONS IT HAS NO SUPERIOR.

Pamphlets giving directions regarding mixture of sand for all kinds of work sent on application.

"GLOBE" (Belgian Portland Cement).

Tested by N. O. Olson, Engineer of Fairbank's Testing Dept., with the following results: Average tensile strength of five briquettes Neat Cement, seven days, **462 pounds per square inch.** Average tensile strength of five briquettes, one part Cement, two parts Sand, **172 pounds per square inch.**

The Globe Portland Cement has been furnished to the following contracts:—

Broadway Cable Road, New York City	40,000 bbls.
Foundation Terminal Warehouse, New York City	15,000 bbls.
Foundation Power House, Brooklyn City R. R.	15,000 bbls.
Baltimore Cable Road	10,000 bbls.

BERRY & FERGUSON, Agents for New England, Office, 102 State Street, BOSTON, MASS.

The Alpha Portland Cement.

Its superiority is fully established; for fineness, uniformity of color, and great tensile strength it is unexcelled. Every barrel of "ALPHA PORTLAND CEMENT" guaranteed equal to the very best brands of "German Portland Cements," and its minimum tensile strength guaranteed as follows:

GUARANTEE.

1 day in air, 6 days in water,	400 lbs.	Neat test Per square inch.
1 " " " 27 " " "	500 "	
1 " " " 3 months in water,	600 "	
3 parts of sand to 1 of cement.—Adhesive test.		
1 day in air, 6 days in water,	125 lbs.	Per square inch.
1 " " " 27 " " "	175 "	

FINENESS.

Residue on sieve No. 50,	None.
" " " " 100,	10 per cent.
Passing through sieve No. 200,	65 " "

Every barrel guaranteed to stand the boiling test, the test for safety.

SOLE NEW ENGLAND AGENTS,

JAMES A. DAVIS & CO., - - - - No. 92 State St., BOSTON.

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ATLAS PORTLAND CEMENT.

WARRANTED EQUAL TO ANY AND SUPERIOR TO MOST OF THE FOREIGN BRANDS.

OFFICIAL TESTS, Nos. 3567 and 3568, made by the DEPARTMENT OF DOCKS, New York, March 31, 1894, being part of contract No. 464 for 8,000 barrels.

TENSILE STRENGTH, 7 days, neat cement	622 lbs.
" " 7 days, 2 parts sand to 1 of cement	332 lbs.
Parts steamed and boiled	Satisfactory.

All our product is of the first quality, and is the only American Portland Cement that meets the requirements of the U. S. Government and the New York Department of Docks. We make no second grade or so-called improved cement.

ATLAS CEMENT COMPANY, 143 LIBERTY STREET, NEW YORK CITY.

BURHAM BRICK LIME AND CEMENT CO. LIMITED
BURHAM WORKS
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ENGLISH PORTLAND CEMENT celebrated for Reliability, Chemical Purity, Great Strength, High Sand Carrying Capacity and General Uniformity. Quantity imported yearly far greater than any other brand.

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CIMENT PORTLAND
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PAVIN DE LAFARGE
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"Lafarge"

French Portland Cement, the only material to use for setting, pointing, and backing LIMESTONE and GRANITE.

Will not stain and makes the strongest binder.

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34 Clark St., CHICAGO.

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is a superior quality of Hydraulic Cement. Especially manufactured for ***important engineering*** work, such as ***Sewers, Reservoirs, Heavy Foundation, Masonry, Conduits, etc.,*** requiring a high grade testing cement. Over ***30,000*** barrels of this cement have been used lately, on the new dams, for the Croton aqueduct. All this cement was subjected to the engineer's test, and not one barrel was rejected. We respectfully call the attention of Engineers and Architects, requiring a high grade cement to our "Crescent" brand. Samples furnished on application.

BERRY & FERGUSON,
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Boston, Mass., Eastern Agents.

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35 STONE STREET, NEW YORK CITY.

Mannheimer Portland Cement.

UNEXCELLED IN QUALITY.

"The results of tests with standard quartz are far above the average of most cements."
CLIFFORD RICHARDSON,
Inspector of Asphalt and Cements,
Engineer Dept., Washington, D. C.

"This brand of Portland Cement was found especially qualified for the purpose of concrete casting on account of its perfect uniformity, intensive fineness, progressive induration after the first setting, and of its great tensile and crushing strength."
Vide Report of CARL A. TRIK,
Superintendent of Bridges, Philadelphia,
On Concrete Arch Highway Bridge over Pennypack Creek.

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FIREPROOF FLOORS (Ransome System).

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Contracts taken for all work in Portland Cement Concrete.

Foundations, Bridge Piers, Engine Beds, Retaining Walls, Pavements, Self-supporting Sidewalks and Sidewalk Lights (Ransome Patents).
Best Materials and Highest Skilled Workmanship.

31 STATE STREET, WORTHINGTON BUILDING.

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The Strongest Natural Hydraulic Cement Manufactured in America. In Successful Use for the past Fifty Years.

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MORTAR
COLORS DO NOT FADE
Nor WASH OUT.

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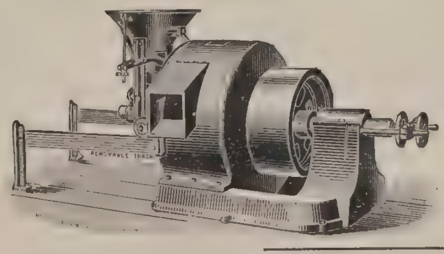

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AND PATENT

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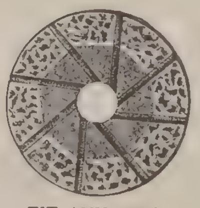
MARK.



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Fastest fine grinder known.
Sturtevant Patent Vertical Mill has no rival for reducing ***Plaster, Paints, Chemicals, Carbons, Talc, Soapstone, Slate, Barytes*** and like materials. 30" Mill Costing but $400, grinds to fine powder from 1 to 4 tons per hour. No foundations, no screens, no noise, no dust. Remember that for $400 you have a machine that is ***ready to run*** and that will keep running longer without repairs than any other fine grinder. Send for special circular.

Made of Blocks of Rock Emery set in Metal, making the hardest and most cutting millstone ever built, and not expensive.

A Customer Writes:

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We can grind from 70 to 75 bbls. Louisville Cement per hour with your Rock Emery Stones. This is from 10 to 15 bbls. more per hour than our ordinary stones will grind. Since May 3 have dressed these but twice. Ordinary Stones we dress every three days. Rock Emery Stones save us several dollars per week in dressing alone.

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RAPID — because Rock Emery has no equal for cutting qualities. ECONOMICAL — because Rock Emery is the most durable grinding surface known. NO EXPERIMENT — because many large manufacturers in your own line already use and indorse them, and hundreds in use for other purposes.

SEND FOR CIRCULARS AND REFERENCES.

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The highest grade of Portland Cement manufactured. Costs no more than GOOD grades of imported cement. Used in foundations of Brooklyn Bridge, Old Orchard Shoal Lighthouse, Mississippi Jetties, sea walls at Sandy Hook and League Island Navy Yard, New York Docks, etc. Approved by eminent engineers. Pamphlets on application.

IMPROVED ANCHOR.

Cost only 25 per cent more than Rosendale Cement. Has a strength equal to Belgium Portland. Manufactured by an admixture of ***Saylor's Portland*** and Rosendale Cement, thereby largely eliminating the un-uniform quality of Rosendale and other natural cements. Used with safety in the largest masonry dams, retaining walls, etc. ***43,000 Bbls.*** 1893, and ***65,000 Bbls.*** 1894. Used in sewers and bridges by the Department of Public Work, Philadelphia. Send for test, etc.

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NORTH'S PORTLAND CEMENT WORKS.

NORTH'S CONDOR BRAND FINEST QUALITY REGISTERED IMPORTERS EDWIN HALL & CO. PHILA. PA. PORTLAND CEMENT

CONDOR BRAND.

One of the best and cheapest high grade **ARTIFICIAL PORTLAND CEMENTS** on the market.

Awarded **FIRST GRAND PRIZE** at the **ANTWERP EXPOSITION, 1894.**

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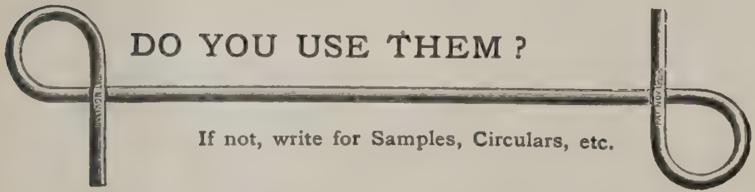
IMPORTERS AND SHIPPERS.

Progressive Architects Use the ∴

∴ **Morse Patent Wall Tie**

For bonding Hollow Walls, Brick Facings, etc.
It is Strong and Reliable.

DO YOU USE THEM?



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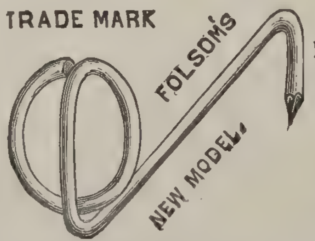
FOR OLD AND NEW ROOFS, SLATE, SHINGLE AND TILE.



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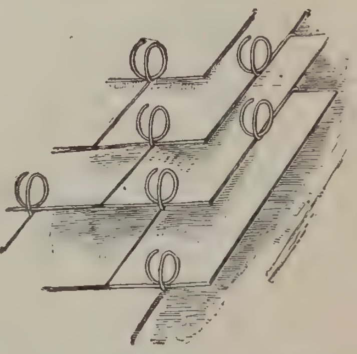

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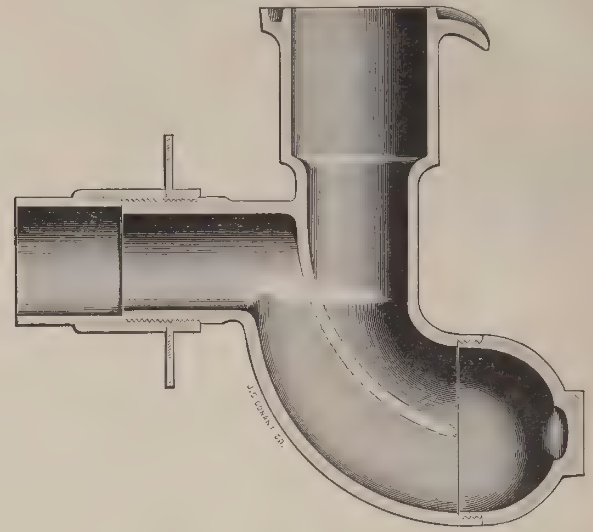

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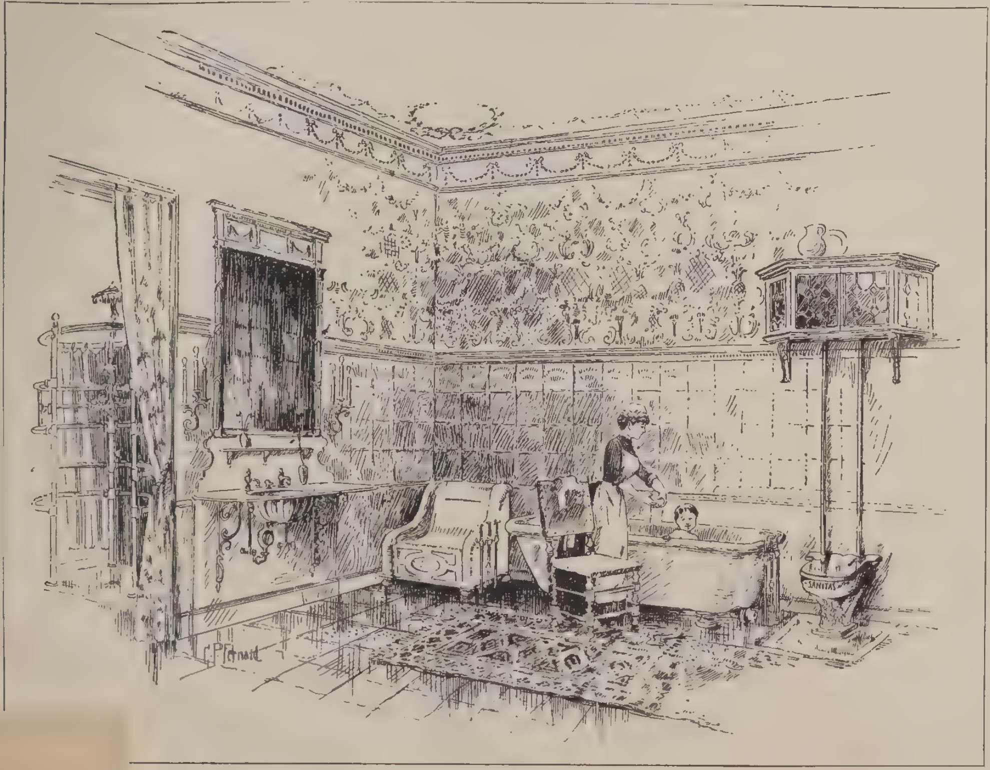

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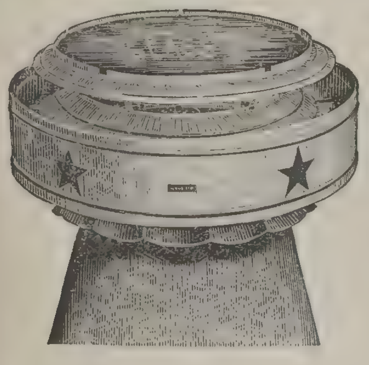

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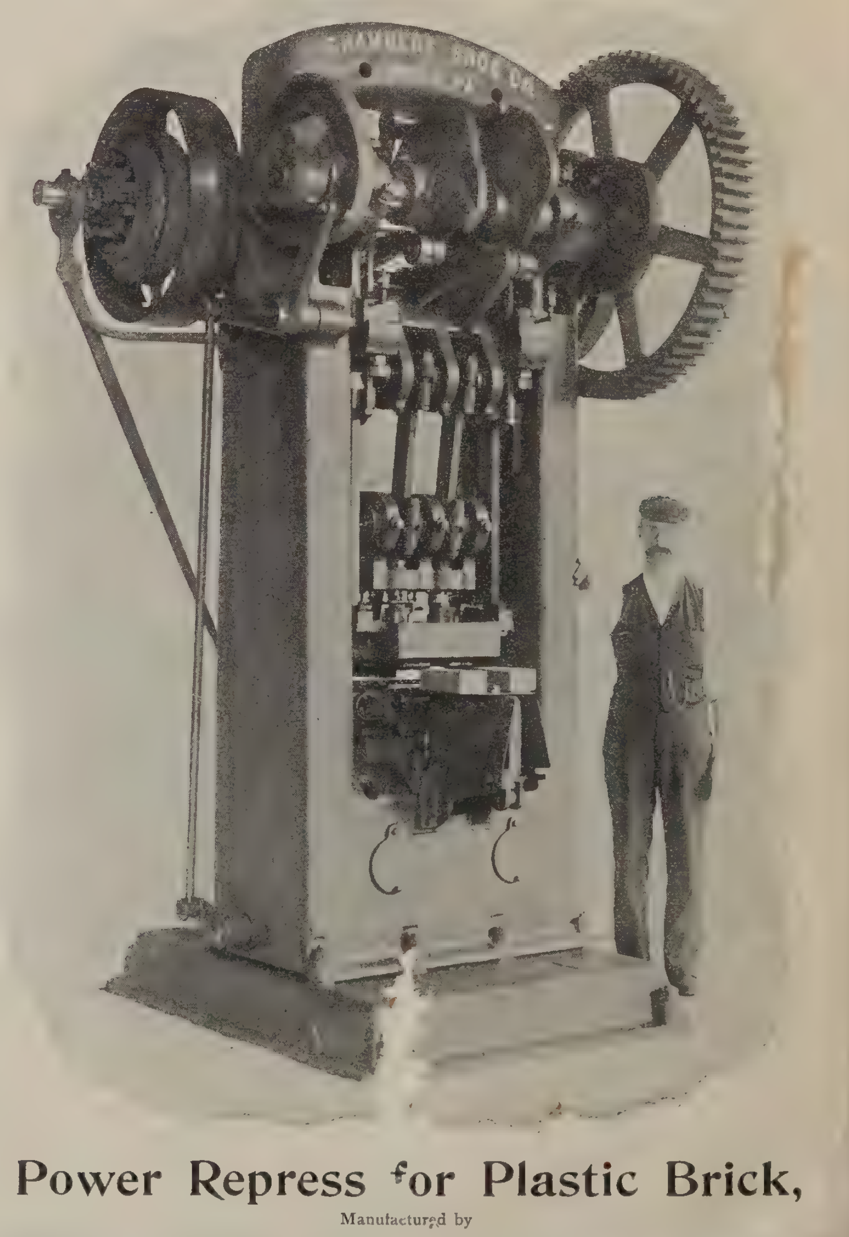

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